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Reconnaissance in British Guiana, with Comments on Microgeography

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PROLOGUE

Among the several types of recent geographic work the following study may be put categorically in its place. It is regional geography and not systematic, since it deals with the complex of phenomena in an area. It is pure geography and not applied, since it is directed toward understanding phenomena as they are without an ulterior motive of reform. It is academic but not pedagogical.

It is human geography and it is anthropocentric, but it is not anthropogeography as narrowly defined and not human ecology. The viewpoint is not that of environmental determinism or controls or influences or responses or even adjustments or relationships.

It is not Geopolitik, though it has a touch of political geography, as well as economic and ethnographic. It is not culture-form geography, though it takes account of the topography of art. It is not genetic morphology. But it is concerned with landscape, with areal association of observable phenomena, with pattern of terrene occupance. Regional units both of static areal homogeneity and of dynamic areal organization are taken into consideration.

The study is chorologic and not cosmologic. Within chorology it is microchoric rather than macrochoric. It belongs essentially in the field of microgeography. The study deals primarily not with all of British Guiana but with two plantations on the coast, occupying less than 1/10 of 1% of the area of the colony (Fig. 1).

FIG. 1.—Location of Plantations Enmore and Hope in British Guiana.

[Drawn from: British Guiana Dept. of Lands and Mines: *Map of British Guiana 1: 3,168,000* (1915).]

GENERALIZED SETTING

Preliminary ideas about this spot in British Guiana are supplied by maps showing major divisions of South America. The two plantations are in the area of **Af-Am** climate,[1] characterized by heat and moisture in every season. They are in a similarly great area of selva,[2] equatorial rain forest. They are within the lowland plains of South America.[3] They are within the area characterized by laterite soils.[4]

These broad generalizations are useful, but they are only a beginning of geographic understanding. They are so broad as to be necessarily thin and coarse grained. These plantations are in the region of laterite soils, but they have no laterite soil on their land. Their vegetation cover is not selva and never was. In the generalized maps there is nothing to suggest a basis for the contrast in population here found,[5] a density of less than 1 person per square mile over most of the equatorial lowlands and a density of more than 250 per square mile in the spot under consideration.

[1] P. E. James: *An Outline of Geography* (New York, 1935), p. 438, plate 4.

[2] P. E. James: "The Distribution of Population in South America" in *Geographic Aspects of International Relations* (Chicago, 1938), fig. 3.

[3] *Ibid.*, fig. 2.

[4] V. C. Finch and G. T. Trewartha: *Elements of Geography*, (New York, 1936), plate IX.

[5] P. E. James: *op. cit.*, fig. 1.

A close-up view of this spot provides a focussed picture within the misty frame of regional generalization.

ENMORE AND HOPE

The two plantations, Enmore and Hope, are strips of land extending inland from the sea shore about seven miles (Fig. 2). The land is a smooth

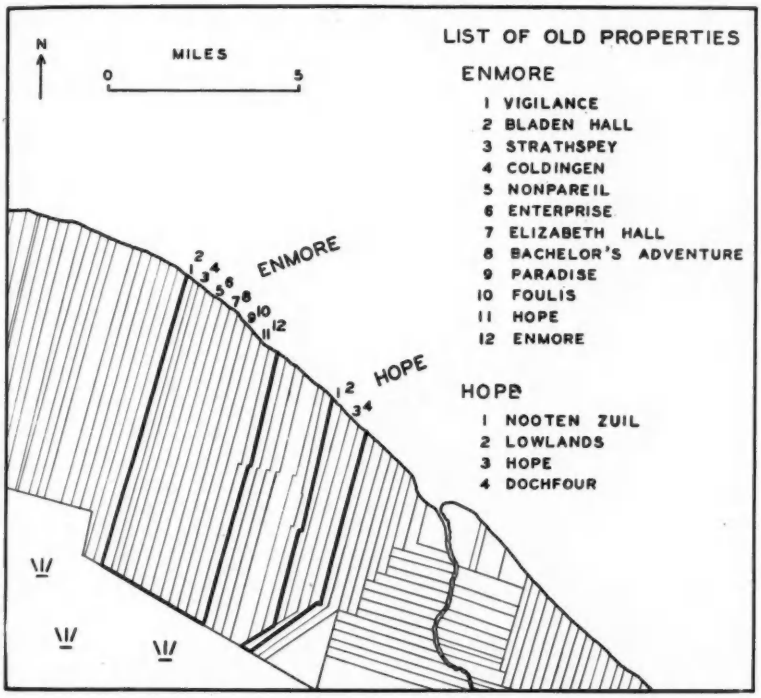


FIG. 2.—Consolidation of old plantations in Enmore and Hope. Neighboring old plantations are similarly consolidated but these other groupings are not shown.

[Drawn from: British Guiana Dept. of Lands and Mines: *Plan of the Sea Coast of British Guiana 1: 190,080* (1925.]

plain of dark heavy soil, below the level of high tide at its seaward margin, sloping imperceptibly upward toward the interior. The greatest irregularities are works of man, and these are intricate and massive (Fig. 3): a wall to protect the front against the sea; a back dam to protect the inland end against runoff from the land; and between these bulwarks a system of

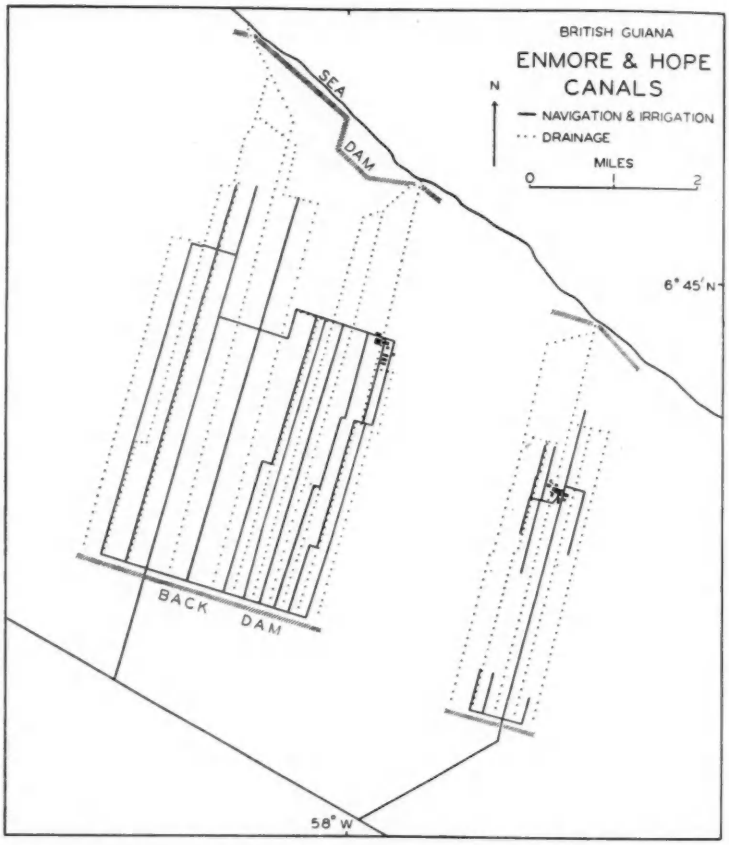


FIG. 3.—Two systems of canals between sea dam and back dam, Enmore and Hope. [Data from: Cadastral maps of the plantations; reconnaissance.]

drainage canals to carry excess water to the sea, and a system of navigation canals bringing a supply of water from the land.

The system of water control is commensurate with recurrent conditions of flood and drought. The rainfall, averaging almost 90 inches annually,[6]

[6] 89.08 inches mean annual precipitation, coastlands stations, 1846–1922; maximum 132.58 inches; minimum 44.93 inches [Meteorological records, *British Guiana Handbook*, 1922 (Georgetown, 1923), pp. 279–287]. 88.29 inches mean annual precipitation, Georgetown, 1880–1935; 86.35 inches total annual 1935; 104.09 inches total annual 1936; 23.27 inches December, 1936, maximum month; 1.47 inches August, 1936, minimum month [*British Guiana Blue Book*, 1936 (Georgetown, 1937) sec. 29].

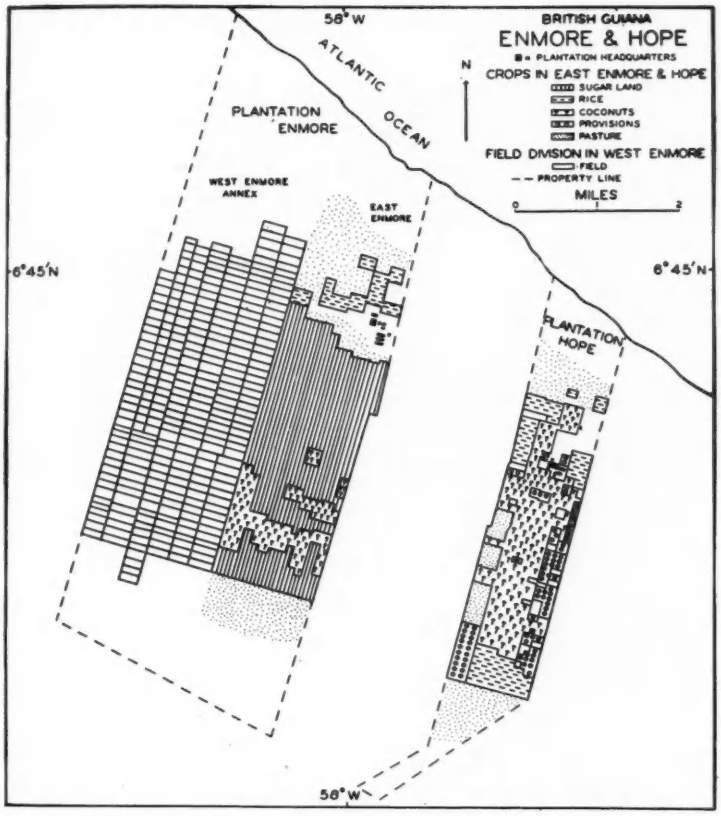


FIG. 4.—Land cover in east Enmore and Hope, 1935; field division in west Enmore. [Data from: Cadastral maps of the plantations; reconnaissance.]

is characterized by regular seasons of concentrated fall and by irregular periods of abnormal excess. At times the drainage system is taxed to the uttermost. Conversely there are regular seasons of light precipitation and irregular periods of drought. At such times the navigation canals provide a convenient supply of water for irrigation, drawn both from nearby marshes and from the runoff of interior uplands, diverted to the plantation. All major crops are irrigated, and flood fallowing of fields is practiced between crops.

Old fields at the seaward end of the property within the front dam are sour and waterlogged and their cultivation has been abandoned (Fig. 4).

FIG. 5.—Sugar cane harvest, Enmore, September, 1935. Cane loaded on steel punts; navigation-irrigation canal; mule tow path on field dam at the left; central mill smoke-stack appearing above standing cane in the background.

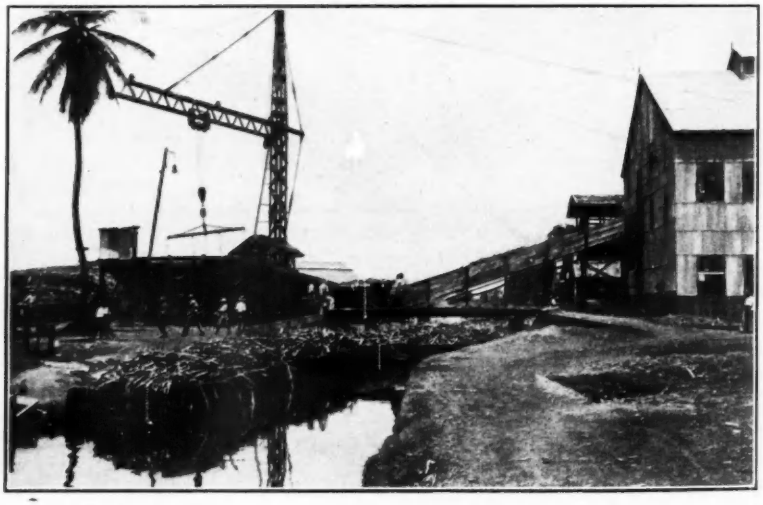


FIG. 6.—Navigation canal in front of the central mill, Enmore. Cane unloaded from punts by crane, and conveyed into the mill on inclined belt.

Virgin land of marshy savannah at the interior end of the property beyond the back dam is exposed to floods and unprovided with canal systems. Accordingly cultivation is confined to an intermediate body of land.

Sugar cane occupies the bulk of cultivated land in Enmore (Fig. 5), both in the eastern half (as shown on the map, Fig. 4) and in the western half (where only the gridiron of fields is indicated in Fig. 4). Sugar represents the survival of an old plantation interest, survival with changes through two centuries: from Dutch to British possession; from African slave labor to East Indian free labor; from bonanza production on newly reclaimed land to specialized production with irrigation and commercial fertilizer on old land; from small scale processing with animal power in the mills of twelve separate plantations (Fig. 2) to consolidation of the twelve into one plantation and large scale manufacture of sugar and rum in a central mill (Fig. 6).

In contrast to these changes of personnel and procedure the layout of plantation lands has changed very little from that planned by the first settlers and executed by their slaves under Dutch rule. The pattern of empoldered fields still reflects the linear arrangement of the twelve constituent plantations (Fig. 4), the same drainage canals still carry water to gates in the sea wall (Fig. 3), and the same navigation canals still carry boat loads of cane from fields to sugar mill.

In Plantation Hope the bulk of the crop land is occupied by coconut

FIG. 7.—Coconut harvest, Hope, September, 1935.

FIG. 8.—Rice harvest in "back dam" fields, Hope, September, 1935.

FIG. 9.—Plantation cattle grazing in wet savannah. View southward from the back dam, Hope, September, 1935.

FIG. 10.—Owner's house, Plantation Hope.

FIG. 11.—Laborer's house privately built, Hope. There are also rows of shingled houses in the plantation, built by the management.

palms (Figs. 4 and 7). Until a decade ago Hope also was a sugar plantation, but smaller than Enmore, composed of only four slave plantations (Fig. 2). Its obsolescent mill was abandoned in the post war sugar depression, and a new owner has put the land to a new use. Coconuts are planted in the fields formerly occupied by cane, in the same heavy acidic soil, similarly drained, irrigated and fertilized. The new productive enterprise is a success.

At both Enmore and Hope there is another important crop: rice (Figs.

FIG. 12.—Air view of neighboring plantations west of Enmore. Looking southwest from above the coast: sea dam across the picture in the foreground; patch of shore thicket and wet savannah outside the sea dam below; drainage canals converging on a gate in the dam; highway and railway across the picture in the middle distance; old idle fields between sea dam and highway; village and sugar mill beyond the highway; cultivated land in the background; back dam near the horizon, wet savannah beyond.

4 and 8), grown independently by East Indian laborers. Most of the land allotted for this purpose is along the seaward side of the cultivated area, where the water table is high and seasonal flooding almost unavoidable. In addition to the "front rice" there is a smaller tract of "back dam rice," on the landward side of the cultivated area, where irrigation water enters the plantation and is available for ample flooding.

Beyond the rice fields both ends of the plantations are used as unimproved pasture (Fig. 4), at the front the old waterlogged fields, and at the inland end the undrained savannah (Fig. 9), where cattle graze.

The two plantations and their subsidiary villages contain about nineteen hundred dwelling houses (Figs. 10 and 11) occupied by eight thousand people.[7] Of the inhabitants 69% (5,578) are "East Indians," from British India, supplying the rank and file of field labor; 23% (1,875) are negroes, most of them born in the colony, supplying gang labor for special jobs and for headquarters; less than 1% (58) are white people born in the British Isles, representing ownership and management.[8] The organization is a

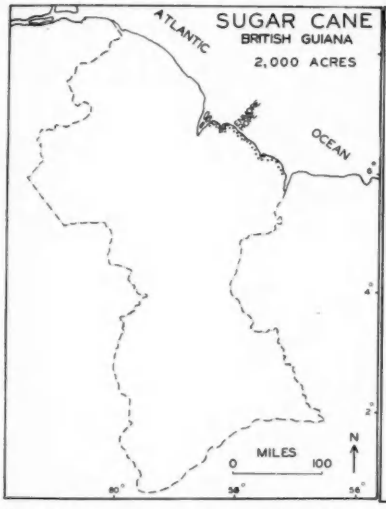


FIG. 13.—Sugar cane acreage in British Guiana, 1936.

[Data from: *British Guiana Blue Book*, 1936 (1937), sec. 22, pp. 2 and 5.]

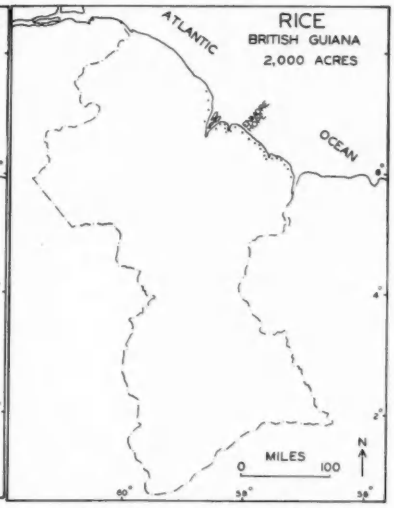


FIG. 14.—Rice acreage in British Guiana, 1936.

[Data from: *British Guiana Blue Book*, 1936, sec. 22, pp. 2 and 5.]

[7] 1,904 inhabited houses, and 8,065 persons in 1921. British Guiana Census Commissioner: *Report on the Census, 1921* (1922), pp. 19–21. The figures throughout this paragraph are derived from these three pages.

[8] The remaining 7%, 554 people in 1921, are Portuguese, Chinese, and "mixed races." *Ibid.*, pp. 19 and 20.

benevolent paternalism, surviving like the earthworks from a past regime.

There is a gap between these microgeographic facts and the broad generalizations of regional maps. General ideas of selva and sparse population do not apply to the plantations. Nevertheless these spots do fit into regions, and it is a geographic problem to see how they fit and to proceed from details to complex regional concepts following preliminary generalizations.

COASTAL SETTING

Reconnaissance by air along the coast reveals the extent of occupance resembling that of Enmore and Hope (Fig. 12), in a single row of plantations, fronting on the shore and backing into wet savannah, extending along part of the coast and terminating sharply against uninhabited savannahs and shore thickets.

This extent of plantations is reflected in the distribution of the leading crops of British Guiana: sugar cane (Fig. 13), rice (Fig. 14), and coconuts (Fig. 15). The concentration of people in the same area (Fig. 16) indicates that the southeast coast is the heart of British Guiana. In fact, the

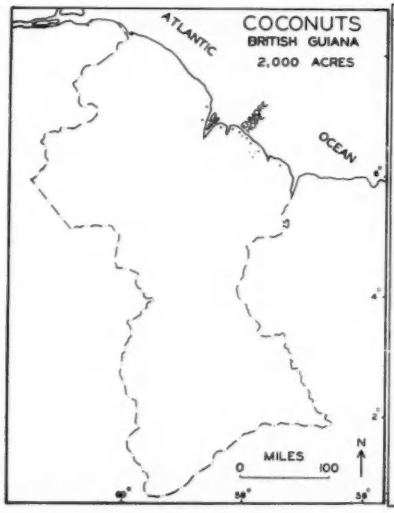


FIG. 15.—Coconut acreage in British Guiana, 1936.

[Data from: *British Guiana Blue Book*, 1936, sec. 22, pp. 2 and 5.]

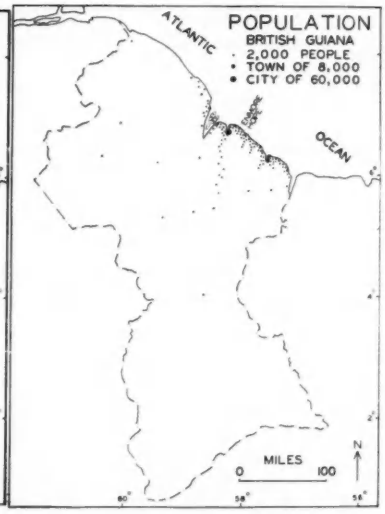


FIG. 16.—Population in British Guiana.

[Data from British Guiana Census Commissioner: *Report on the Census, 1921* (1922), pp. VI–IX, 9, 18–25, 30, 40–46, 52–56, 67. *British Guiana Blue Book*, 1936, sec. 15, p. 1.]

concentration is so nearly complete as to suggest that this district is not only the heart but almost the whole being of British Guiana as a phenomenon of human occupance.

Such overwhelming concentration in a small district is not explained by facts thus far given. The regional maps of climate, soil and vegetation do not distinguish between coast and interior. Only one of the maps previously mentioned, that of surface configuration,[9] marks off the coastal plain from interior hills.

Another general map, that of lithic regions,[10] makes a significant distinction, showing the Guiana coast as an area of recent alluvium, in contrast with the interior region of crystalline rocks. It appears on the map as the only coastal area of alluvial soils in tropical South America. Its location between the two great rivers, Amazon and Orinoco, is noteworthy—particularly its relation to the Amazon. The Orinoco has a delta, but not so the Amazon, and it has been said, to the distress of patriotic Brazilians, that the Amazon delta is carried away by coastal currents and deposited on foreign shores.

The chief beneficiaries of this process appear to be the Guiana colonies. British Guiana has a particularly wide strip of alluvium and French Guiana a narrow strip. In fact the coastal plain of French Guiana is interrupted where foothills of the highlands extend to the water's edge.

Thus in British Guiana recent alluvium enriched by the humus of wet savannahs, in contrast with laterite hills of the interior, provides a setting for plantations. But this does not account for concentration along only part of the coast. Interpretation of this fact involves consideration of an intricate distribution of features significant in the sequent occupance of Guiana.

LOCAL HISTORICAL SETTING

The plantations of the present utilize massive earthworks of the past, the most immobile of cultural immobilia. Canals and dikes constructed by slave labor have been improved in modern times but not much extended. The distribution of the present is an acceptance of a distribution of the past, which in turn was based on other past considerations.

At the beginning of colonial occupance in Guiana a primary interest was trade with Indians, and for this purpose important sites were on rivers reaching the interior. The greatest of Guiana rivers is the Essequibo. A Dutch trading post occupied a site near the head of navigation and became a center of colonial activity.[11] (Fig. 17).

Plantations were established along the Essequibo. But these were not

[9] P. E. James: *op. cit.*, fig. 2.

[10] V. C. Finch and G. T. Trewartha: *op. cit.*, plate VI.

[11] Source of data on the sequence of past events: A. R. F. Webber: *Centenary History of British Guiana* (Georgetown, 1931).

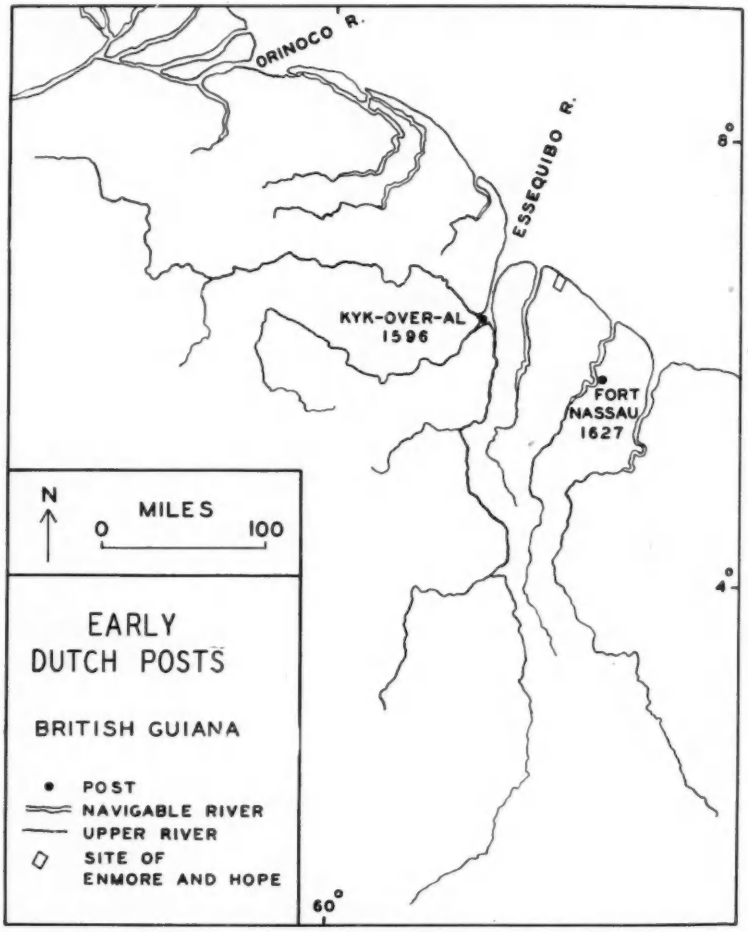


FIG. 17—Two early Dutch posts in the area which later became British Guiana.

[Data from: A. R. F. Webber: *Centenary History of British Guiana* (1931), pp. 6, 7, 9, 11, 35; British Guiana Dept. of Lands and Mines: *Map of British Guiana 1: 3,168,-000* (1915); American Geographical Society: *Millionth Map of Hispanic America*, Georgetown and Alto Trombetas sheets (1930); Stieler's *Atlas of Modern Geography*, Guayana, 1: 5,000,000 (1935); etc.]

productive, and agricultural settlement spread to the coast. There water control problems were greater but familiar Dutch methods were rewarded by greater returns.

Establishment of coastal plantations proceeded in both directions from the Essequibo. But toward the northwest were Spanish settlers on the Orinoco who interfered with the Dutch and disputed their claims. Toward the southeast were small separate centers of Dutch settlement. Accordingly a vigorous administration on the Essequibo closed the northwest to settlement and threw open the coast to the east.

The period of expanding settlement with slave labor and sugar scarcity came to an end, while the western boundary controversy with Spain and then with Venezuela dragged on to the end of the 19th Century. In recent years established plantations have been maintained, but incentive to establish new districts has been lacking.

Thus localization of settlement along part of the coast is intelligible, if we take for granted the original European spheres of influence as historical

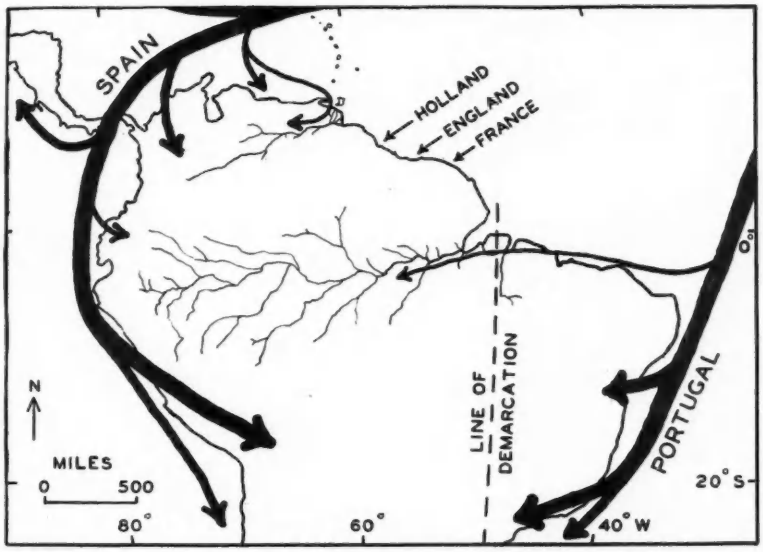


FIG. 18.—Tropical South America: Line of Demarcation, streams of European colonial activity, and Amazon and Orinoco waterways to heads of navigation.

The Line of Demarcation, to separate Spanish and Portuguese interests, 1494, is drawn according to Ribeiro, 1529, [S. W. Boggs: "The Map of Latin America by Treaty" in *Proceedings of the American Philosophical Society*, Vol. 79 (1938), p. 401]. The streams of European activity are impressionistic, without quantitative basis for direction, length or breadth of lines. Data for Amazon and Orinoco waterways from same references as fig. 19, and from R. S. Platt: "Conflicting Territorial Claims in the Upper Amazon" in *Geographic Aspects of International Relations* (1938), pp. 260 and 262. Base from Goode's series, no. 201HCW.

accidents, Spanish activities in one area and Dutch, English, and French in others. But such historical accidents have a geographical setting traceable in larger regional facts.

REGIONAL HISTORICAL SETTING

When Spain and Portugal dominated America and divided the New World between them, their spheres of influence were separated theoretically by a north-south line (Fig. 18). But practically these spheres were separated by a wide zone of relatively unattractive territory between the rich discoveries of Spain in the western highlands and those of Portugal in the

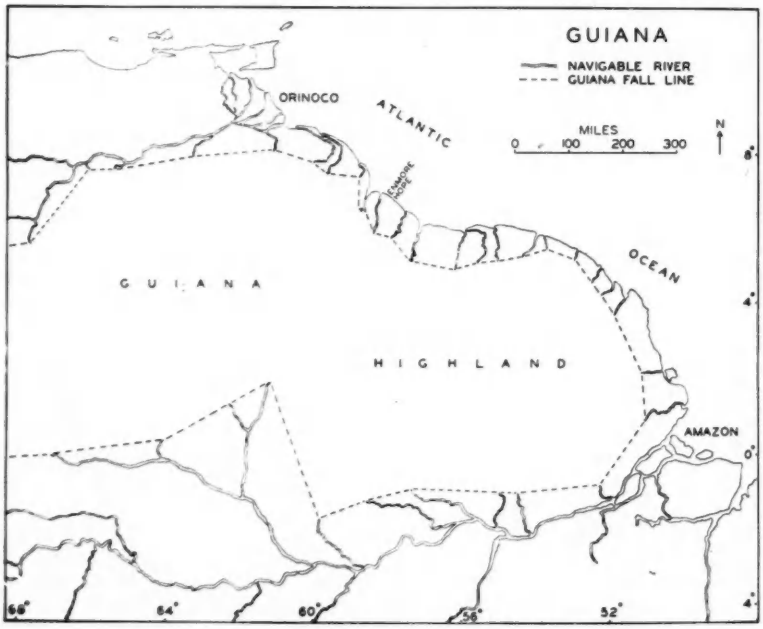


FIG. 19.—Guiana highlands and principal adjacent rivers navigable from the sea. The "fall line" is indicated by straight lines drawn between the heads of navigation.

[Data from: American Geographical Society: *Millionth Map of Hispanic America*, Georgetown (1930), Cayenne (1929), Alto Trombetas (1930), Amapá (1929), Putumayo-Içá (1930), Manáos (1930), Santarém (1930), Pará (1932), Rio Juruá (1930), Rio Purús (1929), Rio Tapajós (1934) and Rio Araguaya (1931) sheets; Club de Engenharia do Rio de Janeiro: *Millionth Map*, Roraima, Uaupés, and Rio Branco sheets (1922); A. Jahn: *Mapa Geológico de Venezuela 1: 2,000,000* (1921); Stieler's *Atlas of Modern Geography*, Guayana 1: 5,000,000 (1935); J. G. Bartholomew: *Commercial Map of South America* 1: 10,000,000 (1900); etc.]

Brazilian highlands (Fig. 18). Theoretically the Guiana coast lay near the boundary between Spanish and Portuguese territory, on the Spanish side of the line. Practically this coast was a backwater far from the main streams of Spanish and Portuguese activity.

Only secondary lines of activity reached toward this backwater. Spanish activity to the Orinoco from north and west, and Portuguese to the Amazon from south and east, weak efforts which spent themselves at river outposts and extended along the rivers rather than into Guiana between the two.

The Guiana interior was and still is relatively uninviting (Fig. 19), offering only small rewards in return for penetrating beyond a girdle of cataracts, into selva, among stubborn Indian tribes. The Spanish and Portuguese had good reason to view the area between their respective rivers as a boundary zone, separating their spheres of influence and not worth vigorous conquest. Gold resources of Guiana, unlike those of the Andes and Brazil, were not mined until later times, late in the 19th Century.

There were, to be sure, 16th Century reports of Guiana gold. But

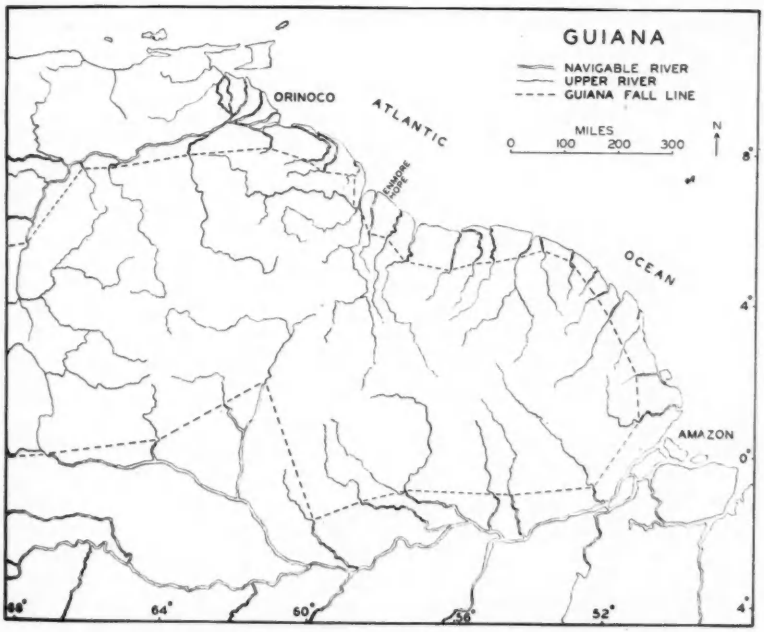


FIG. 20.—Guiana highlands, adjacent navigable rivers and upper rivers above the lowest breaks in navigation.

[Data from: Same references as fig. 19.]

when Sir Walter Raleigh tried to penetrate to legendary El Dorado and advertised Guiana as an opportunity for fortune seekers, it was only as a consolation prize to England, after all known sources of wealth had been acquired by Spain and Portugal.[12] And the prize did not then materialize.

So the insignificant posts of Holland, England and France on the Guiana coast and similarly insignificant posts of Spain on the Orinoco and Portugal on the Amazon were concerned with affairs on their own water fronts, and only secondarily with far off neighbors and the highland wilderness between the heads of navigation. Along upper rivers to headwaters (Fig. 20) penetration was about equally feeble from all three sides. Penetration across divides was limited to savannahs (Fig. 21), chiefly near the Orinoco.

Present day boundaries coincide with the divides, except in savannah

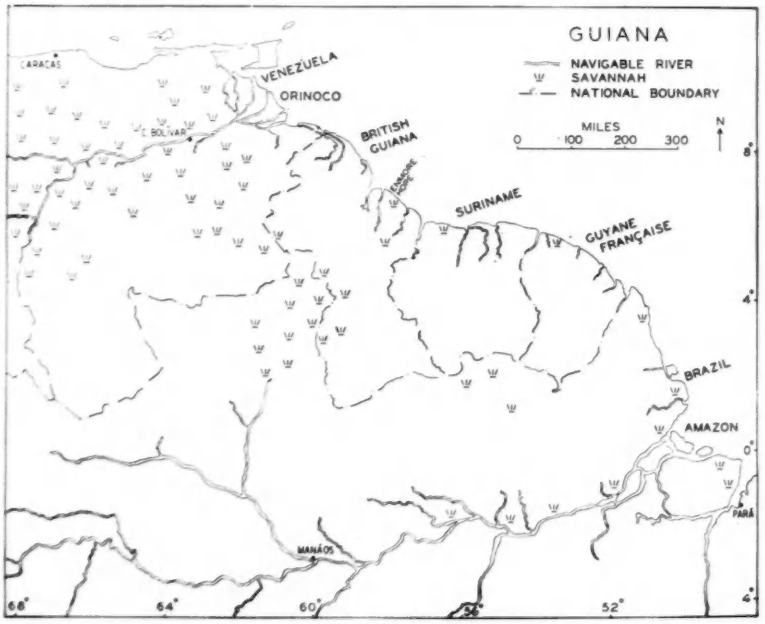


FIG. 21.—Areas of savannah, Guiana highlands.

[Data from: *British Guiana Blue Book*, 1936, Sec. 22, p. 2; British Guiana Dept. of Lands and Mines: *Map of British Guiana, 1: 3,168,000* (1915); H. Pittier: *Mapa Ecológico de Venezuela, 1: 2,000,000* (1920); P. E. James: "Population in South America," *Geographic Aspects of International Relations*, (1938), Map of Natural Vegetation in South America, p. 232; and same references as fig. 19.]

[12] W. Raleigh: "The Discovery of Guiana," in *Hakluyt's Voyages* (New York, 1927), Vol. 7, pp. 272–280, 344–350.

FIG. 22.—Major stream divides and national boundaries, Guiana highlands. [Data from: Same references as fig. 19.]

areas, and near the Amazon mouth, where weak French occupance was dislodged by pressure from Brazil (Fig. 22). At the Orinoco mouth British Guiana was not pushed far from the river, but Spanish pressure on that side was felt nevertheless, as indicated in Dutch prohibition against settlement northwest of the Essequibo, and expressed on the British map today[13] in the concentration of plantations east of the Essequibo (Fig. 23).

Thus a microgeographic area in Guiana, evidently not typical of broad regional types, and even appearing at first like an abnormality in the coarsely-woven blanket of generalized regions, is found by reconnaissance

[13] To trace the changes of sovereignty in the part of Guiana held by England, Holland and France would not serve the purposes of this study. Each of the three nations has claimed the whole area and has controlled the whole at one time or another. In the several settlements one sovereignty has succeeded another without breaking the continuity of occupance; present inhabitants are cultural descendants, though not blood descendants, of past inhabitants. The present division represents a 19th century status which lasted long enough to jell.


ORINOCO R.
PLANTATIONS
BRITISH GUIANA
PLANTATION
NAVIGABLE RIVER
ESSEQUIBO R.
ENMORE HOPE
6°
4°
2°
N
MILES
0
100
60°
58°

FIG. 23.—Plantations in British Guiana. Individual properties are not shown precisely, due to small scale of map. In areas of plantation abandonment property subdivisions are not indicated.

[Data from: British Guiana Dept. of Lands and Mines: *Map of British Guiana 1: 1,000,000* (1924); *Ibid: Plan of the Sea Coast of British Guiana 1: 190,080* (1925); and American Geographical Society: *Millionth Map of Hispanic America*, Georgetown sheet (1930).]

study to be a normal feature of a coherent plantation district, which in turn has a consistent place in the intricate geographic pattern of South America.

EPILOGUE

This study illustrates plainly enough what microgeography is and does as an opening wedge to further knowledge of regions. Yet such detailed field method as that used in the two plantations has been subject to misunderstanding on the part of some writers who have not been eye-witnesses of field work in microgeography, nor participants in discussions current during the past fifteen years among geographers experimenting in this type of study.[14] This is not surprising in view of the difficulty of interpreting a contemporary thought movement at second hand from fragmentary publications and opinions. Therefore it seems appropriate to account for the movement from first-hand acquaintance.

Microgeography is a logical development in modern method, begun before the World War and still evolving—not a fad of the 1920's now abandoned. Its leaders have been familiar with post- and pre-war geography, geological and botanical field techniques and military mapping, and have been conscious of defects as well as contributions of both environmentalism and ecology. The movement is easily understood as a rational and timely drive against the limitations of armchair compilation from promiscuous data, of subjective impressions from casual travel, and of environmental theory not founded on observed data.

The occasion has called for objective data, congenitally geographical, specifically located in areal association. Field work is a prerequisite, and in the field is an old obstruction: the geographer's dilemma in trying to comprehend large regions while seeing at once only a small area. In the field all geographers are "microscopic." Those whom others have called "micro-

[14] G. Pfeifer: "Entwicklungstendenzen in Theorie und Methode der regionalen Geographie in den Vereinigten Staaten nach dem Kriege," in *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, vol. 1938, pp. 93–125.

J. O. M. Broek: "Neuere Strömungen in der Amerikanischen Geographie" in *Geographische Zeitschrift*, vol. 44 (1938), pp. 249–258.

These articles have appeared in Germany but both authors have been connected with the University of California at Berkeley,—Pfeifer formerly (1929–31) as a fellow, and Broek now as an assistant professor.

scopic" are geographers that have not leaped to sweeping generalizations, but have chosen to work patiently with the fundamental stuff of which all true generalizations are composed, not forgetting the complex areal association of geographic phenomena.

From the outset workers in microgeography have recognized the problems of fitting their data into a world framework, into genetic categories, and into time as well as space. Problems have been segregated; items have been published as partial solutions, as experiments in methodology, and as samples to create standards and aid integration.

As a valid and useful part of regional method microgeography is carried on today with increasing effectiveness, thanks to experience and constructive criticism. Expectations are being fulfilled, and results in regional geography show signs of advance toward geographic understanding of the earth in larger parts and as a whole.

University of Chicago,
January, 1939.

Monterrey and Northeastern Mexico*

SAMUEL N. DICKEN

Monterrey is the commercial and industrial capital of northeastern Mexico (fig. 1) and the most vital link between Mexico and the United States. It is growing rapidly, is now the third city of the Republic in population, second in manufacturing, first in metallic industries. Most of northeastern Mexico is tributary to Monterrey, especially Nuevo León, Tamaulipas and Coahuila; a much larger area is partially dependent. The modern, efficient factories draw ores, coal, cotton, clay and grain from various localities, and produce large quantities of steel, lead, silver, ceramics and beer. Twenty-seven thousand people are engaged in manufacturing.

To study Monterrey is to realize its importance, but to the casual observer little in the immediate vicinity seems to warrant a city. On the road from the north, either along the Pan-American Highway or the National Railway, one is confronted with montonous, brush-covered piedmont or rugged mountains (fig. 2) and save for a few towns the land appears almost unoccupied. The route from the east is similar in its barrenness, the road crossing mile after mile of chaparral which is broken only by scattered patches of cultivation. On the approach from the west, via Saltillo, there are high, semi-arid ranges and arid valleys, even less productive than the Piedmont. From the south the impression is more favorable; the broad corn and cane fields of Linares give way to the well-kept orange groves of Montemorelos and Allende. This is productive piedmont country efficiently irrigated but scarcely extensive enough to justify the presence of a large city in the vicinity. There is too little cleared land, far too much brush.

This apparent paradox of a city without a productive hinterland is resolved along two lines. First, the brush country is by no means as sterile as it seems, having coal, iron ore, lead, shale for cement, clay for pottery, grain, sugar and cattle. In the second place, Monterrey, thanks to its favorable position with respect to raw materials, and its nearness to the United States, has appropriated a large share of the industrial activity of all Mexico at a time when the country is beginning to feel the impact of the machine age. Raw materials pour in from a dozen states which lack the facilities to process them. Iron ore comes from Durango, coal from Coahuila, lead and

* This study was aided by a grant from the Fluid Research Funds of the University of Minnesota.

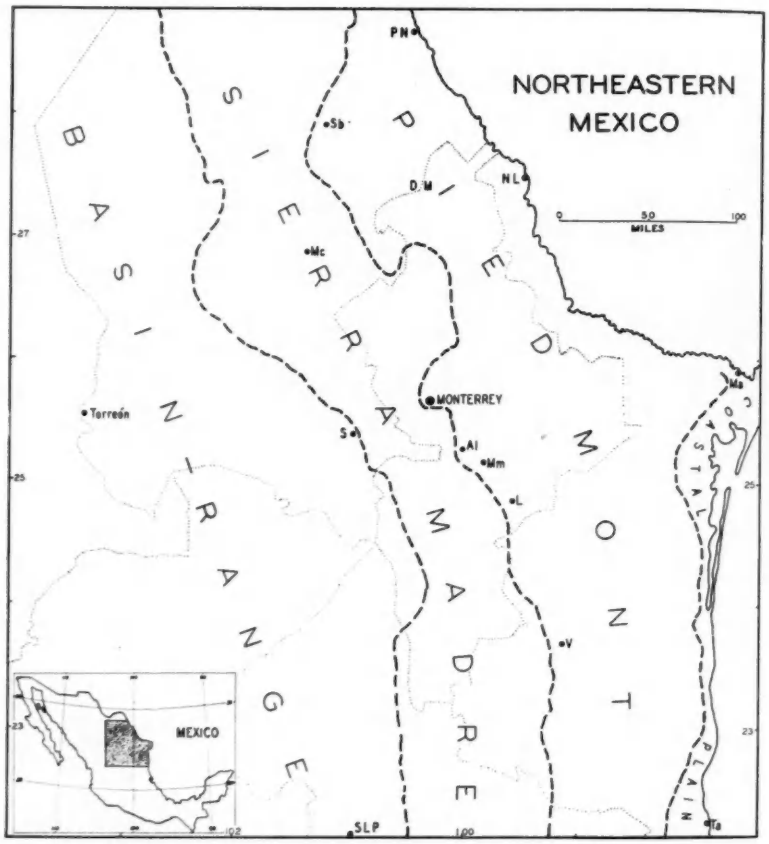


FIG. 1.—Sketch map showing Monterrey's position in northeastern Mexico. Four broad physical regions are indicated: the Basin-Range, the Sierra Madre Oriental, the Piedmont, and the narrow Coastal Plain.

Data are not available to mark out the trade area of Monterrey but it includes, without doubt, most of northeastern Coahuila, nearly all of Nuevo León and the northern half of Tamaulipas.

Localities referred to in the text include Piedras Negras (PN), Monclova (Mc), Saltillo (S), Sabinas (Sb) and Torreón in Coahuila; the Don Martín (DM) cotton district, largely in Nuevo León; Montemorelos (Mm), Allende (Al) and Linares (L) in Nuevo León; Nuevo Laredo (NL), Matamoros (Ma), Victoria (V), and Tampico (Ta) in Tamaulipas; and San Luis Potosí (SLP).

FIG. 2.—A view of the Piedmont on the mountain margin in north central Nuevo León.

silver ores from as far south as Guerrero.[1] In turn Monterrey distributes its manufactured products and in addition handles a large share of the imports from the United States.

SITE

Monterrey is located on the broad fan-like flood plain of the Santa Catarina River near the point of emergence from the Sierra Madre Oriental. The plain is hedged in by mountains except to the north and northeast, the city occupying an embayment between the ranges (figs. 3, 4). To the south and west the front range of the Sierra rises 6000 feet above the city; to the west is Las Mitras, an elongated dome; to the southeast La Silla, a saddle-shaped arch, marks the northern end of a long anticlinal ridge.

The alluvial plain slopes gently eastward from an elevation of 1800 feet in the northwestern part of the city to 1700 feet in the northeast, in a distance of about five miles. The surface is smooth except for the channel of the river and two smaller channels which drain the springs. The surface material of the plain is weathered alluvium, consisting of alternate layers of gravel or boulders and silt. Where large fragments are dominant on the surface there is a thin layer of residual soil, but in some of the silty areas

[1] *Anuario de Estadística Minera, Año,* 1932, 36–70. Secretaria de la Economia Rural, Departamento de Minas. México, D.F., 1935.

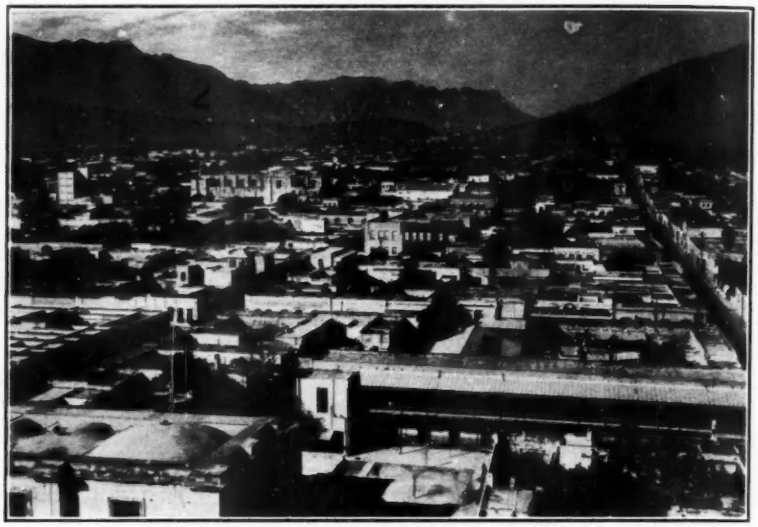


FIG. 3.—West Monterrey and the Sierra Madre as seen from the Palacio Federal.
1. Loma Larga, crest line dotted.
2. Sierra Madre.
3. Cerro Obispado, crest line dotted.
4. East flank of Las Mitras.

there are well developed A and B horizons. Bed rock is evidently at great depth since most wells reach water at 90 to 120 feet without encountering it.

The river bed is intrenched to a depth of about 20 feet (fig. 12), has a variable width from 300 to 1800 feet. It is dry even in the wet season, except after heavy rains; ordinarily the water flows underground in the vicinity of the city. The bed of the river furnishes gravel, sand, stone and lime for building; the lime kilns on the south bank use limestone boulders gathered from the river bed. Temporary houses were formerly built in the bottom of the channel but several recent floods destroyed all such structures and further building is prohibited. The open channel is far from an advantage to the city; the flood hazard and the stagnant pools of water which remain after rains, affording breeding places for mosquitoes, have called forth a plan for the diversion and canalization of the river.

The three springs which attracted the first settlers to the site of Monterrey were bordered by groves of walnut, oak and avocado trees. The water supply was sufficient for domestic use and for irrigation of the plain below the city, but as the city grew the significance of the springs became less and

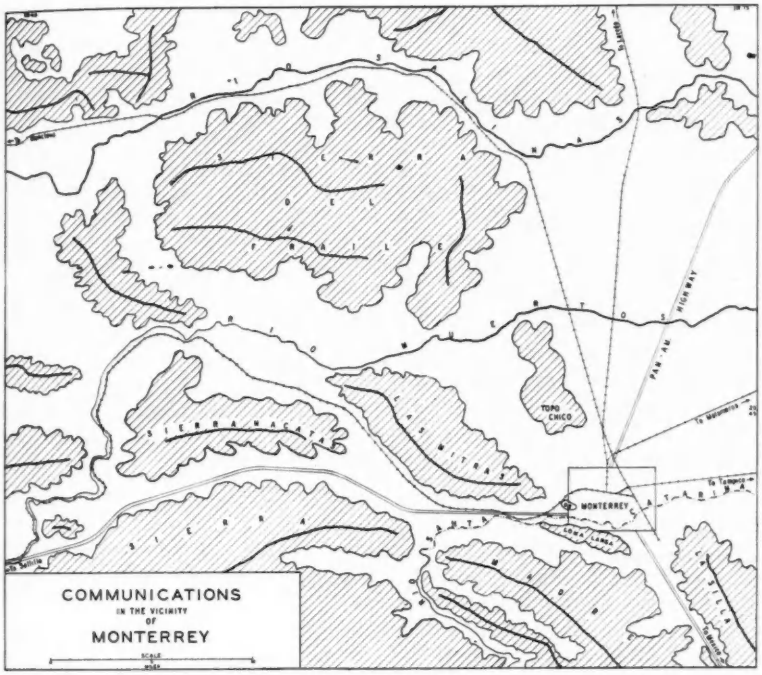


FIG. 4.—Sketch Map of the vicinity of Monterrey, showing the principal lines of communication. Communication is fairly easy except toward the southwest where lofty ranges bar the way. South of Monterrey for more than 200 miles there is no feasible route for a railway to reach the plateau. The railroad to Saltillo is part of the main line from Laredo to México, D.F., and the one to Monclova continues to Piedras Negras. The mountains and hills are shaded down to the alluvium and the heavy lines show the trend of the ridge crests. (Modified from the Carta República Mexicana a la 100,000).

less and after a number of wells had been sunk the flow declined. Spring water is sufficient today for a large swimming pool and for use in the steel mill.

The site of Monterrey has the advantage of almost unlimited room for expansion, especially toward the north. The sub-surface is easy to excavate yet firm enough for ordinary building. Underground streams, springs and numerous wells supply good water. There is the disadvantage of the flood hazard which is not too difficult to overcome.

PHYSICAL SETTING OF MONTERREY

The mountain ranges and foothills which all but surround Monterrey

(fig. 3) are elongated limestone ridges, separated by valleys filled with alluvium. The strata are strongly folded, less noticeably faulted and the almost vertical dips near the crests of the ridges produce knife-edge summits. The conformality of the surface to the dip of the limestones is striking and the slopes are uniformly steep. The folds and ridges have a distinct curvilinear pattern following the strike of the limestones; some of the ridges are widely spaced, others are separated only by narrow canyons. The pattern of ridge and valley in the vicinity of Monterrey limits communication to the south and west; the steep slopes limit the land use to browsing and fuel gathering; the elevation and the limestone cores insure an abundant supply of underground water to the plains below. A few of the ridges and foothills near Monterrey merit separate descriptions.

Aside from La Silla and Las Mitras which may be considered independent ranges, there are a number of foothill ridges asssociated with the Sierra Madre. Immediately to the south of the city is Loma Larga (long ridge), extending from the foot of Las Mitras eastward, curving to the southeast and eventually merging with the La Silla range several miles to the southeast of the city. It is a long, narrow anticlinal ridge, rising from 150 to 300 feet above the plain, broken by the Santa Catarina River near Las Mitras and at other points by smaller transverse streams. Loma Larga is separated from the main body of the city by the bed of the Santa Catarina River and since Mexicans prefer to build houses on a plain, only the lower slopes have been occupied. Most of the ridge is used as pasturage for goats. As on Cerro Obispado, where the advantages of an elevated site are being realized, Loma Larga may become in the future the location of an exclusive residential district. It has already played an important role in the building of the city. On the lower and intermediate slopes is a deposit of *caliche* several yards in thickness. Quarried, carved into blocks and dried, it hardens and under the name *sillar* (hewn stone) it constituted the major building material of the city until very recently. It is cheap, abundant, and structurally strong enough for three- or four-storey buildings, but its high permeability has led to replacement by concrete blocks, brick and hollow tile, as these materials became available.

Another foothill, similar to Loma Larga, but shorter, is Cerro Obispado (Bishop's Hill) near Las Mitras. Structurally it is an outlier of Las Mitras formed by the end of the plunging anticline, but it is isolated by a former channel of the Santa Catarina River. The hill rises about 150 feet above the plain and the lower slopes are occupied by a modern residential section. Topo Chico, to the northwest of the city, is the dome-like end of a ridge, the structure and surface conforming perfectly. Most of the other foothills are spurs from the Sierra Madre.

Las Mitras and La Silla are of about the same height, rising more than 3000 feet above the plain. Both are elongated, steeply sloping domes with irregular longitudinal profiles. Las Mitras has several projections which resemble a bishop's mitre, La Silla has the outline of a saddle, as seen from Monterrey. The steep slopes continue downward and meet the plain in a sharp angle, with but little development of alluvial fans since there are no surface streams. There are limestone quarries on both mountains and small inactive lead mines.

Between the ranges and foothills, the Santa Catarina River has followed, successively, three distinct courses, not only increasing the alluvial plain area in the immediate vicinity of Monterrey but also affording alternate routes for roads and railways. The most southerly and oldest course passes to the south of Loma Larga, thence to the north of La Silla (fig. 4). This abandoned flood plain is the site of an excellent market garden district, irrigated by water from the upper river and from several spring-fed streams in the mountains. Alluvium from the Sierra to the south has filled this plain in the eastern part to an elevation greater than the present flood plain of the river. The second course of the river is the present one, flanking Loma Larga on the north. The third led to the west and north of Cerro Obispado and the site of the city; the railroad from Monterrey to Saltillo utilizes this course.

The first range of the Sierra Madre rises abruptly behind Loma Larga, presenting a lofty, notched and jagged skyline. Monterrey is marginal to the curving trend of the range, the ridge curving westward toward Saltillo and southward toward Victoria. The lower slopes are shale but steep and with but little fan development. There are occasional benches on the intermediate slopes which afford small areas of nearly level land. One of these, Chipinque, is the site of a summer colony. Above these benches the abrupt slopes of the limestone become almost vertical as the summit is approached. Steep draws are filled with limestone rubble. Running water is found on the upper slopes only during rains but there are numerous springs on the intermediate and lower slopes.

Corresponding to the range in elevation and exposure in the vicinity of Monterrey there is much local variation in climate. The city has an annual average precipitation of 28 inches,[2] with a decided late summer maximum (Sept. 8 inches) and a less marked late winter minimum (March .6 inches). The coldest month is January with an average of 58° F., the warmest August with 80.5° F. Monterrey belongs in the **BSh** climate of Köppen, and in the **DB'd** of Thornthwaite but is toward the wet margin. Comparison with

[2] *Promedios de Temperatura y Lluvias de 1921 a 1935*, 13. Direccion de Geografia, Meteorologia y Hidrologia. Tacubaya, D.F., 1937.

Matamoros, Tamps., near sea level and in almost the same latitude, indicates that Monterrey is influenced by altitude and nearness to the mountains. Matamoros averages 85° F. in August, a difference of about one degree for every 300 feet in summer. Comparison with Cadereyta, 25 miles east of Monterrey, in smooth piedmont country, shows that only the late summer precipitation may be greatly affected by the nearness of the mountains. Cadereyta has a total precipitation of 31 inches, .9 in February, 7 inches in June, 4.7 in September. Although records are lacking there is every indication that the mountains near Monterrey receive more rain than the city, particularly on the eastern slopes in the face of the rain-bringing winds. The more frequent clouds on the mountains, the density of the vegetation in spite of the physiologic dryness of the limestone, is sufficient testimony to the greater precipitation. The distribution of rain is not unfavorable for crops since many crops can be cultivated in any season of the year. Northward and eastward from Monterrey the precipitation decreases; to the south in the vicinity of Montemorelos and Linares it increases, a fact which is indicated by the natural vegetation.

The natural vegetation in the vicinity of Monterrey includes a wide variety of species. Briefly the formations may be described as chaparral on the plain, which extends also to the summits of the foothills and outlying ridges; oak forest on the intermediate slopes of the Sierra, and pine forest near the summit. The chaparral of the plain is dominated by mesquite, but there are numerous other species. Along the streams and near springs there are live oaks, walnuts, avocado and cypress. Mingled with the chaparral in many locations are several varieties of cactus and agave. On the lower slopes of the mountains the chaparral is much denser and may be penetrated only with difficulty. The woody plants are higher, reaching to 10 or 12 feet. With greater altitude the oaks and other shrubs take on the size of trees in a rather open forest formation. This continues almost to the crest of the Sierra where a limited area of pine forest struggles for its existence on the steeply dipping limestones. On the lee side the chaparral reaches the crest.

In spite of the variety of vegetation there is a limited economic use; the chaparral and the oak forest furnish wood for fuel, still used in many of the houses of Monterrey for cooking. Much of this fuel which is of small size, is cut at some distance from the city and brought in by burros, ox-carts and occasionally in trucks. A limited amount of lumber is cut for building and for furniture making; farther back in the mountains there are numerous sawmills. The most important use of the natural vegetation, however, is for grazing; the foothills and lower slopes of the sierras, and the plain where conditions are not favorable for agriculture, are dotted with flocks of goats, for which the brushy vegetation is best adapted. Here and there in the

chaparral of the plain there is a good stand of grass in between the bushes but in many parts grass is lacking.

With light rainfall most of the year and surfaces underlain either with limestone or alluvium it is natural that most of Monterrey's water should come from underground. The larger supply comes from the Santa Catarina River which is ordinarily dry in the vicinity of Monterrey. Below the bed there is always water and the intake for the Cerro Obispado Reservoir is about 60 feet deep. It is probable, in the light of what has already been said, that most of this water supply comes from the alluvium rather than the bedrock, but it is equally clear the alluvium is often cemented almost as hard as country rock. Well water is available in all parts of the city.

There are two diversions of surface water: one is in the Santa Catarina River above the point of engulfment and is used only for irrigation. The other is in Estanzuela Canyon which flows eastward from the front range of the Sierra Madre about nine miles south of Monterrey. It is not unlike many other canyons in similar locations. The head of the canyon is impassable, rising almost vertically with the steeply dipping limestones of the Sierra Madre. The upper course cuts mainly across the strata but occasionally follows the strike for a short distance. The canyon bottom is filled with large boulders of limestone and some sandstone; the shales break up readily and are less in evidence. As is commonly the case, the canyon is fed by numerous springs below which the water enters a closed conduit and is brought to the city with the aid of siphons.

COMMUNICATION

To the north, east, and southeast of Monterrey, there are only minor hindrances to communication while to the west, despite the apparent imprisoning influence of the mountains, the discontinuity of the ranges affords easy passage. Many of the canyons are partially filled with alluvium, so much so that there have been numerous drainage changes. Furthermore, since most of the drainage is underground the streams themselves are not serious barriers to communication except in times of flood. As a result of valley filling a number of broad corridors lead westward and southward from Monterrey and only to the southwest is the Sierra an effective barrier. In this direction seventeen parallel ranges trending northwestward and westward from Monterrey, block the path.

The route by which the early settlers entered Monterrey was the broad structural valley, filled with alluvium, which leads down from Saltillo (fig. 4). In detail this is a series of valleys rather than one single valley, but nevertheless an easy route is afforded, a bit steep for a railroad, but excellent for a highway. It is significant that this corridor, following the trend

of the ranges and filled with alluvium so that it is broad and easily traversible, is not duplicated to the south where there are only transverse gorges. As the approach is made from southern Mexico and on the plateau, Saltillo is at the entrance of the first easy route leading down to the Piedmont. Thus Saltillo and Monterrey stand at opposite ends of a broad sloping corridor connecting two very contrasting regions.

The most direct route is used by the highway to Saltillo and utilizes the Santa Catarina canyon in the lower part, the Los Muertos valley in the upper part (fig. 4). Los Muertos now drains to the north of Las Mitras, but it is evident that a former course led into the Santa Catarina River and to Monterrey. The shortest rail route follows a similar course, except for a detour to the north of the Sierra Nacatas, via Rio Muertos (fig. 5). An

FIG. 5.—Looking eastward down Los Muertos Valley on the road from Monterrey to Saltillo (see southwest corner of figure 4). The valley is partially blocked at this point by the hills on the left and by an alluvial fan on which the camera rests. The railroad finds an easier route to the north.

alternate rail route to Saltillo, although primarily a short cut to the Saltillo-Piedras Negras line, skirts the Sierra del Fraile on the north, utilizes the valley of the Rio Salinas, and provides an easier but longer route. Almost any combination of these routes is available for highway construction but some are rather steep for railroads. Although there are a number of similar

easy routes to the north of Monterrey, connecting the Piedmont with the Plateau, none afford such direct connections.

GROWTH OF MONTERREY

The settlement of Monterrey and its hinterland is a theme in itself and space here will permit only a brief account of its origin and growth. With the abortive settlement of Monterrey by Carvajal[3] there is little concern. He came overland from Tampico and after a short time the settlement was abandoned; no later settlers were to come into the Monterrey region from the south. The work of Carvajal, however, called the attention of the people of Saltillo to the site of Monterrey, which as late as 1580 was unknown to them.[4] Saltillo was founded in 1575 and the Indians were so hostile, that at first little exploration could be done. In 1596 the permanent settlement of Monterrey was founded by Diego Montemayor at the springs of Santa Lucia (fig. 6), but it was to be hindered by Indian raids for nearly two centuries.[5]

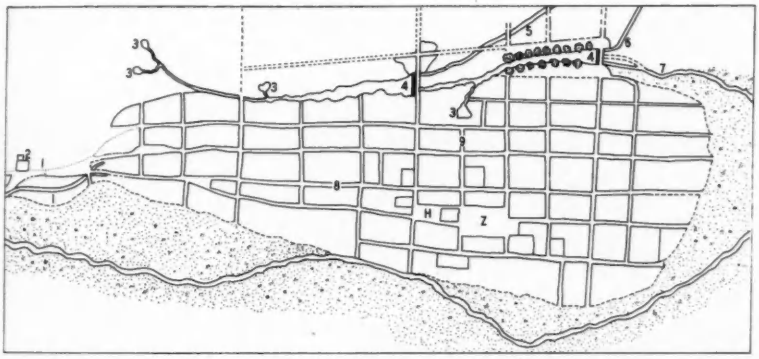


FIG. 6.—A map of Monterrey in 1798 by Juan Crouset. All the blocks were occupied by houses and gardens and the legend of the map noted that 76 new houses had been built since 1793. After the flood of 1612 the town had been rebuilt around the plazas Hidalgo (H) and Zaragosa (Z) which today form the nucleus of the principal commercial core. Water was obtained from the river by means of a ditch (1) and from the springs (3) of Santa Lucia to the northwest. The plain to the east was irrigated by ditches (5, 6, 7), taking water from the reservoirs impounded by dams (4). The streets which formed the axes of the town at that time were Morelos (8), connecting with the road to Saltillo (2), and Zaragosa (9). (Modified after Alessio Robles from the original in the Archivo General de la Nación, México, D.F.)

[3] Leon, Alonzo de: *Historia de Nuevo León*, 73. México, D.F., 1909 (written 1636–61).

[4] Alessio Robles, Vito: *Monterrey en la Historia y en la Leyenda*, 90. México, D.F., 1936.

[5] Berlandier, Luis, y Chovel, Rafael: *Diario de Viaje de la Comision de Limites*, 60. México, D.F., 1850. (In 1828 Berlandier noted that Monterrey had been free from Indian raids for 50 years.)

For 340 years Monterrey has grown, little restricted by its site, limited only by the development of its environs and by poor communication with Central Mexico and the United States. From the original village beside the springs of Santa Lucia, boasting in 1603 only 34 Spanish families, the growth was slow for 280 years. In 1612 a flood, of which many were to follow, all but wiped out the settlement. The site near the springs was low, lower even than the bed of the river and subject to overflow when there were heavy downpours in the mountains. The village was rebuilt on higher ground between the springs and the river, around the present Plaza Zaragosa (fig. 6) which became the nucleus of the modern city. It was above flood stage, though removed from the water supply, and from this point the city grew westward along the ridge of comparatively high land near the river bed. To the east the ridge became lower, was cut off by the curving channel from the springs. To the south was the river bed, to the north low ground; only to the west was it safe to build. By 1800 Monterrey was an elongated town, bordered on the south and east by the river bed, to the north by the canal flowing from the three springs, while to the west, the houses and lands were restricted by Cerro Obispado at the point where the road from Saltillo entered the plain (fig. 6).

The early growth of Monterrey was limited by the settlement of Nuevo León, which in turn was hindered by floods, epidemics and Indian raids. Monterrey was further handicapped by its position aside from the main line of travel and the state began to grow long before the city responded. The population of the state increased rapidly after 1800, that of Monterrey not until after 1880.[6]

In the 18th century an observant traveler would not have hesitated to select Saltillo or Monclova (fig. 1) as the future metropolis of northeastern Mexico. Monterrey was off the main line of travel which led from the City of Mexico to Saltillo and thence via Monclova and Piedras Negras to Texas. Nor was there anything in the city itself to suggest its future growth. In 1827 Berlandier described it thus[7] "[Monterrey] is situated at the foot of the sierra at the northwest [?] extremity of an immense valley. Its area is large but its population scarcely reaches 12,000. The streets are regular, at right angles, and directed more or less north and south, and east and west, but not always straight and badly paved. There are two plazas, scarcely noteworthy, Zaragosa and Hidalgo; the larger [Zaragosa] serves as a market . . . the houses are for the most part low and detached . . . the industry of the city is very limited, most of the people are agriculturists."

[6] *Poblacion de Nuevo León desde 1603 hasta 1921*, 25. Direccion de Estadística. México, D.F., 1909.

[7] Berlandier y Chovel: *loc. cit.*

At this time Texas was a part of Mexico and the town of Monterrey seemed of slight significance when there were so many sites which appeared more favorable. The first person to recognize the importance of Monterrey was José de Noriega,[8] and only after Texas had become separated from Mexico and a part of the United States. He rightly saw that the establishment of an international boundary along the Rio Grande eliminated a number of potential urban centers from northeastern Mexico. In 1856 he referred to Monterrey as "the capital of the frontier."

But acceleration of Monterrey's growth awaited the period of railroad building. In 1880 construction began on the Laredo-Mexico branch of the Ferrocarriles Nacional de México and it was completed in 1888. The railway from Piedras Negras to Torreón was completed in the same year, connecting with the F. N. M. at Saltillo. The line from Monterrey to Tampico began construction in 1888, reached Victoria in 1890 and Tampico the following year. The line from Monterrey to Matamoros was not completed until a few years later.

With the completion of these railroads Monterrey found itself in the most strategic position in northern Mexico. Then, and not until then, the superiority of its situation became effective.[9] It was the focus for five important rail routes which tapped the mineral and agricultural wealth of seven states of northeastern Mexico. With the improved communication industry increased, first in mining where there was a great influx of foreign capital, administered largely from Monterrey. Local industries were especially favored by the progressive spirit of Governor Bernardo Reyes, who in his long period as governor of Nuevo León, 1885–1909, did his utmost to encourage industrial development. It is not surprising then that Monterrey should grow from less than 30,000 people in 1880 to 131,000 in 1930 and with the additional stimulus of the Pan-American Highway, to more than 160,000 in 1937. This growth brought about significant changes in the landscape pattern of the city.

THE URBAN LANDSCAPES

The growth of Monterrey has been largely westward and later with industrial expansion, northward. The city lies almost entirely on the flood plain, except to the south of the river where part of the Colonia Independencia occupies the lower slopes of Loma Larga and in the west where a new residential district occupies the slopes of Cerro Obispado. Today there are two commercial cores, the older and more important one at the

[8] Noriega, José; *Monterrey*. In Apendice al Diccionario Universal de Historia y Geografia. Append. II, p. 884. México, D.F., 1856.

[9] Howell, E. J.: *Mexico; its progress and possibilities*, 102. London, 1892.

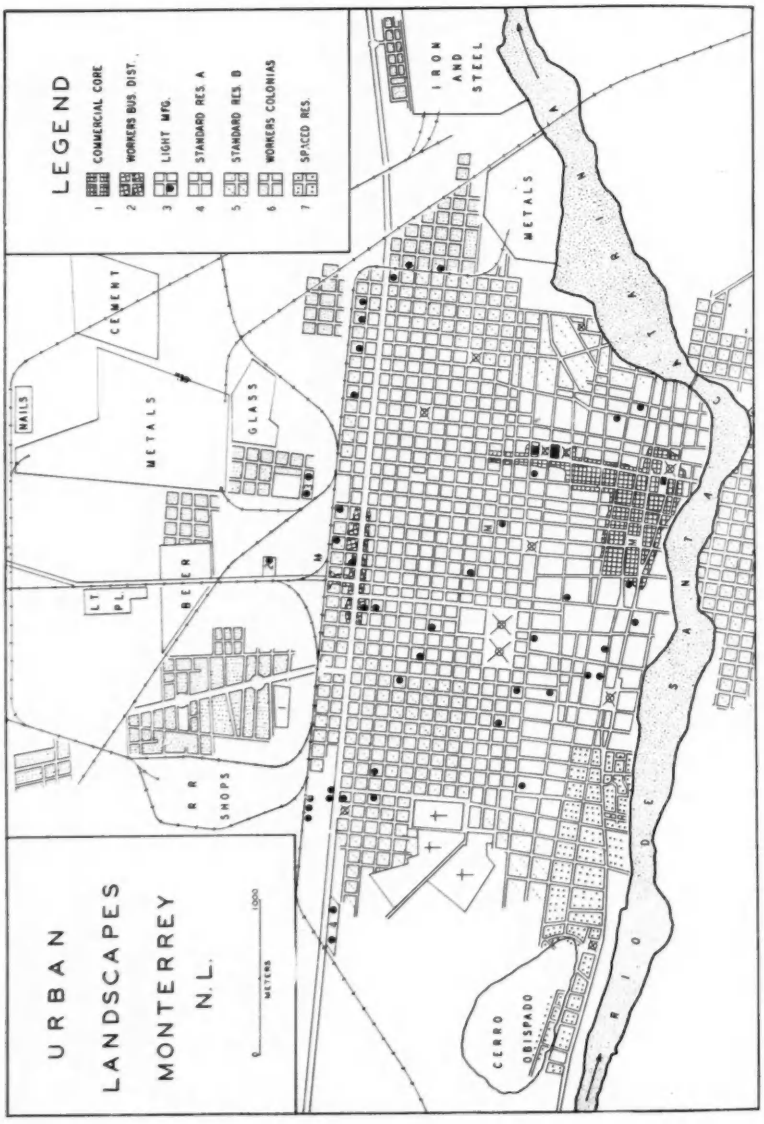

URBAN
LANDSCAPES
MONTERREY
N.L.
METERS
1000
LEGEND
1 COMMERCIAL CORE
2 WORKERS BUS. DIST.
3 LIGHT MFG.
4 STANDARD RES. A
5 STANDARD RES. B
6 WORKERS COLONIAS
7 SPACED RES.
CEMENT
NAILS
METALS
GLASS
BEER
L T
P L
R R
SHOPS
IRON
AND
STEEL
METALS
RIO SANTIAGO
CERRO
OBISPADO

FIG. 7.—Urban Landscapes of Monterrey, Nuevo León. The city lies on an alluvial plain, mostly on the north side of the Santa Catarina River. The main body of the city is near the river bed, and the industrial zone, especially the heavy industries, is to the north and east. Light manufacturing is well distributed through the residential districts. The growth of Monterrey has been largely westward and northward from the nucleus in the southeastern part of the commercial core. Notable in the recent development are the workers' *colonias* within the industrial belt and the new spaced residence district near Cerro Obispado. The solid black rectangles in the commercial core represent public buildings, the encircled crosses locate the plazas.

nucleus of the city and a new one near the industrial zone (fig. 7). The residential districts show great variety from the standard Mexican adobe type with patio, through frame houses to what might be called modern Spanish houses. Four main residential districts may be indicated: the standard type of the older part of the city; the workers' houses of the older part; the modern *colonias,* including Obispado and Mirador; and the new workers' subdivisions. The industrial zone, essentially one unit, lies to the north and east of the old city, making a total of seven types of urban landscape.

The principal business district lies in the southeastern part of the city and corresponds almost exactly with the old site of the city, selected after the flood of 1612.[10] The earliest center was around the Plazas Zaragosa and Hidalgo, from which the growth has extended to the west along Morelos and later to the north along Zaragosa (fig. 6). This commercial district includes 16 complete blocks and parts of several others. Of the two protrusions, the one to the west is the older. The commercial houses are usually found in rebuilt residences in a zone of disintegration similar to that of northern cities. The extension to the north, however, is made up in part of buildings of recent construction which are morphologically commercial. On most of the periphery of this core the appearance of the buildings is residential rather than commercial and but for the signs and business activity they might be considered residences only. Indeed in some cases only careful observation or inquiry revealed commercial or industrial activity.

In the center of the core the buildings are of the common commercial type with large display windows and recessed entrances. Notable is the absence of tall buildings (fig. 8), many of the structures near the center have only one storey, although some buildings of eight to ten floors are under construction. Until recently the tallest buildings were the hotels, two of which had five storeys. The explanation of the low urban skyline lies in the methods of construction and the limitations of material rather than any predilection on the part of the builders. Modern methods of steel construcion are being used and the skyline will undoubtedly change.

[10] Leon, Alonzo de: *op. cit.*, 145.

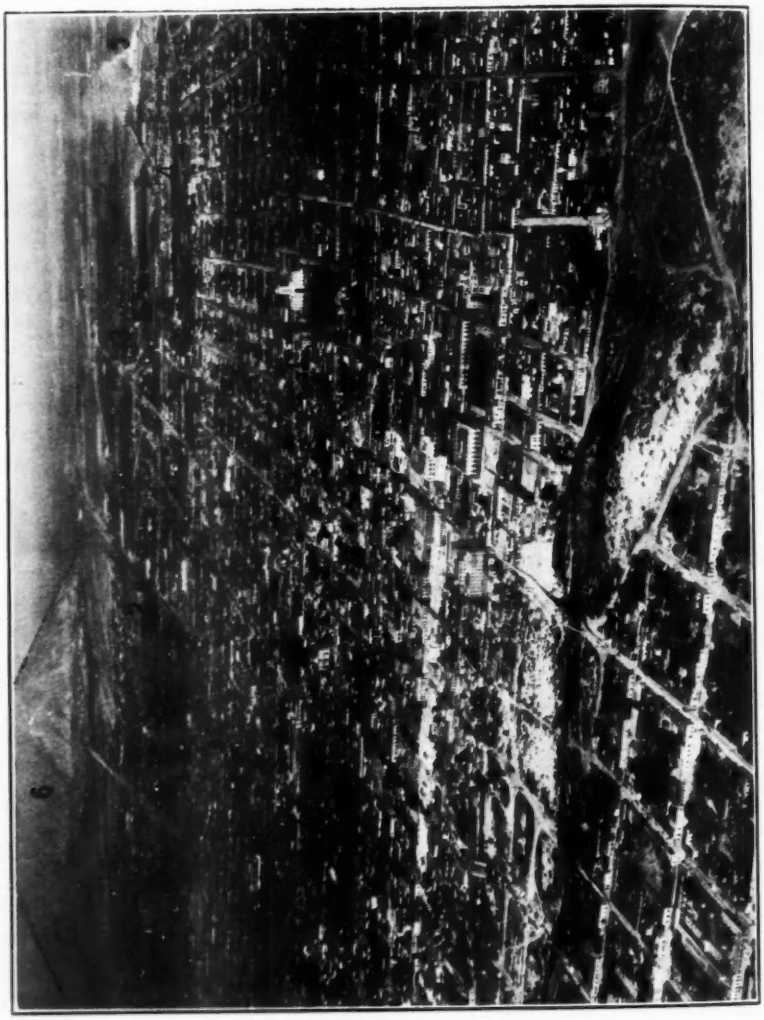


FIG. 8.—Airplane view of Monterrey from above Loma Larga, looking slightly west of north.

In the foreground is the Colonia Independencia and the bed of the Santa Catarina River which at this time (1931) had running water.

Immediately north of the river and near the center of the view is the commercial core which is conspicuous only because of its whiter buildings and the comparative absence of trees.

In the residence districts the tree-studded patios give a distinctive pattern to the city.

The northern part of the industrial zone is in the background; 1. railroad shops; 2. brewery; 3. smelter; 4. glass plant; 5. cement plant; 6. Topo Chico.

In the north central part of the city and distinctly separated from the older district is the commercial center of the workers. It lies along Avenida Madero and, except for the growth northward (fig. 7) toward the railway station, is a "street" district, with nearly all the business establishments facing Madero. It is obvious at a glance that this core is secondary to the larger one—it is smaller and lacks some of the elements of the complete business center. There are no banks, only two small hotels, no large stores. In contrast with the Morelos district, there are no shops catering to tourists, although the highway from the north crosses the area. There are several markets, including the large North Market. The business houses are mostly one storey, their principal difference from the residences being the larger entrance. There are a few small modern shops in one-storey houses built for that purpose. This zone is a symptom of decentralization of the functional business center. It is laid out along a modern street and has several modern qualities but it has also many attributes of the small town business district. Most of the shops cater to the lower income groups and are crowded with cheap merchandise. Notable too are the portable street markets which almost obscure the permanent shops. These have long since disappeared from the Morelos core.

The eccentricity and the narrow street pattern of the older commercial core, as in many other cities, makes it ill-suited to its present use. It fails to provide for future growth, except by taller buildings which will only increase the congestion. Only two streets are wide enough for two-way traffic; the others are one-way, greatly restricting communication in spite of the relatively small number of automobiles and trucks (6,100 in 1937). Therefore, it has been suggested that the new commercial district be developed into the main commercial core. But the banks, hotels and shops of the older core are so firmly established that there seems little likelihood that the suggestion will be carried out. There is a clear tendency, however, toward the union of the two districts along Calle Zaragosa to the Avenida Madero and there may ultimately be a dispersion of certain commercial functions toward the north, with a corresponding decadence on the west.

The characteristic residence of Monterrey is a one-storey rectangular building fronting on the sidewalk, with one door and two or more barred windows on the street side. Usually the wall structure, if not the house proper, occupies the entire lot, within which is the patio or garden (fig. 9).

FIG. 9.—An oblique view of part of Monterrey's residence district. Note the narrow streets, the flat roofs, the variety and spacing of the patios.

The walls are thick, often as much as one meter, and usually of *sillar*. It is this construction, common in the city until recently, which makes it difficult to build multiple storey dwellings, although in a number of cases two storeys have proved successful. Also there is the disadvantage of the added storey from the standpoint of the patio, reducing the light and warmth. The roofs are flat, surrounded by low parapets and are usually accessible from the ground floor. The introduction of the automobile brought out one of the disadvantages of this house type; there is no exterior space and the interior is not accessible. Usually the problem is solved by reconstruction of the front door so that the automobile can be driven into the patio. Though lacking in variety of elevation and plan these houses reveal a wide range of color. The plastered exteriors vary from pastels of tans and browns through yellow and green to pink and salmon. There are a few detached residences similar to those in the Obispado District described below.

From the standpoint of structure and plan most of the houses of the city fall in this classification, but there is a rather obvious diversity in quality as between the inner residential section and that marginal to the city. The plan and structure is the same; the material is the same. The difference lies in the broken plaster, the poorer windows and doors and more noticeably, the unpaved or badly paved streets which are found in the outlying districts of this type.

The houses of the workers are in general marginal to the city and near the industrial plants. This area is characterized by small, poorly built houses, often of wood with metal roofs. Houses of stone, adobe, *sillar* and concrete blocks are common but few are in a state of good repair. The street is commonly unpaved and there is usually no sidewalk. Thus, in wet weather there are many mudholes and in dry times much dust. The masonry houses are often scarred and not recently painted. New houses are being built in various parts, mostly of masonry (fig. 10), a few of wood.

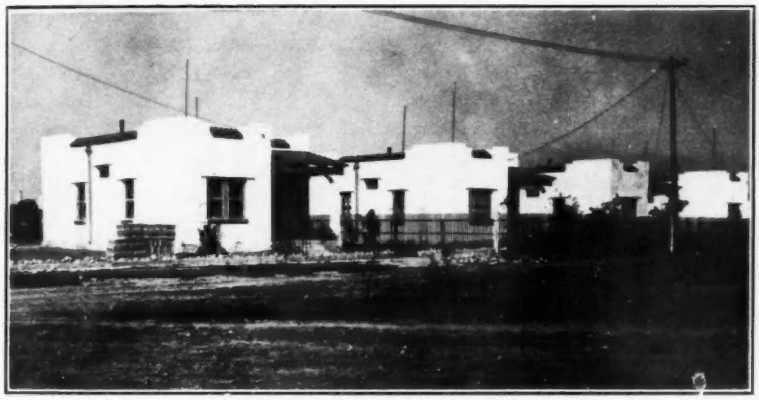


FIG. 10.—New workers' houses in the Colonia Terminal represent a distinct departure from the older types. Other houses near the industrial zone are built of *sillar*, wood or sheet metal.

The acute housing shortage in Monterrey in the last few years has led to the building of a number of workers' *colonias* and several more are under construction. Some of the houses are of good quality, others are obviously temporary.

Near the Cerro Obispado, on the south and west, the detached residence already noted in an occasional occurrence in the older part of the city, reaches its highest development. This district is now only sixteen blocks long and from one to three in width but it is growing rapidly. The location

is the best in the city; not only is it farthest from the smelters but it occupies the highest residential ground within the city limits. The outstanding quality which contrasts with adjoining residential districts is the open space around the house, the lawn and the shrubbery (fig. 11). Some of the larger

FIG. 11.—A modern Monterrey house in the Colonia del Mirador. This is a community of detached houses of various types.

houses have retained the patio as well, utilizing the advantages of both kinds of houses. The house types vary from the square, one-storey Mexican house with flat roof and barred windows, to what might be termed "modern California brick." Materials include brick, concrete, concrete blocks, adobe and the local *sillar*. All except the brick are usually plastered, and painted white on the outside, so that the material is scarcely discernible in the finished house. Flat roofs are most common but there are also sloping tile roofs. Frame houses are entirely lacking. This district is growing westward especially on the south side of Cerro Obispado and also northward at the expense of poor residential districts. Land values are high, running above 250 pesos per front linear meter.[11]

The industrial zone of Monterrey, to the north and east of the older part of the city (figs. 7, 8), is on level land well served by railroads. All rail lines enter Monterrey from the north and east and numerous spurs and sidings reach the various industrial plants without traversing the main body of the city. The factories are widely spaced since there is now little special

[11] The value of the peso at the time this study was made (1938) was approximately 27 cents in United States currency.

advantage in any part of the industrial zone. Formerly water from the springs was important industrially, is still used by the steel plant. This industry also uses the bed of the river for slag disposal. There is a tendency for the lighter industries to focus in the western end of the zone, and for the heavier to locate in the east end (fig. 12). From Loma Larga or an airplane (fig. 8) the various factories spread out in a wide panorama, with open spaces between them, broken only by the workers' *colonias*. From west to east this panorama includes the railroad shops, the cigarette factory, the brewery, the American Smelting and Refining plant, the glass plants, the cement plant, the iron and steel plant and the smelters and refinery of the Cia. Metalurgica de Peñoles; between these more conspicuous structures are smaller factories (fig. 7). Complete records of manufacturing are not available but a summary of the number of employed in the larger factories (over 40 employees each) will indicate the relative importance:[12] iron and steel and associated industries, 2700; glass, ceramics and cement, 2200; furniture, 1250; smelters and refineries, 1200; breweries, 1000; clothing and textiles, 900; food products, not including bakeries, 500; paper and cartons, 460; furnishings, 450. Space will permit individual descriptions of only a few of the more important industrial establishments. In all these establishments the techniques are surprisingly modern and it is not remarkable that raw materials and markets should be found in distant parts of Mexico.

The iron and steel plant of Monterrey (fig. 12) is the most important in Mexico; it produces about 75% of the country's output and employs from 2500 to 3000 men. The ore, principally hematite, comes from Durango (Cerro Mercado), Rinconada, northeast of Saltillo, and from Las Golondrinas, seventy miles north of Monterrey. The ores run about 60% iron with varying amounts of phosphorus and sulfur, usually low. The reserves are large. Coke is obtained from an independent company near Sabinas in Coahuila and is used in the blast furnace only; the open hearth and Bessemer furnaces use natural gas piped from Roma, Texas and northern Nuevo León. Scrap is purchased from the United States and as much as 50% is used in charging the furnaces. Limestone is obtained from Las Mitras, Topo Chico and La Silla and all materials, raw and finished, are handled by rail. The plant includes one blast furnace, a battery of open hearth furnaces, one Bessemer converter, recently installed, a rolling mill, foundry, wire mill and various smaller departments. The production, 150,000 tons per year, consists largely of steel rails, structural steel, castings, railroad car wheels, wire, bolts and nuts. The railroads are the best customers and the products go to all Mexico.

[12] Data supplied by Cámara Nacional de Comercio y Industria de Monterrey, 1938.

FIG. 12.—The industrial east end of Monterrey from the air, looking westward. In the center is the iron and steel plant and at the upper left the smelter and refinery of the Cia. Metalurgica Peñoles. In the foreground is a portion of the broad bed of the Santa Catarina River.

There are two large smelters and refineries in Monterrey, the American Smelting Company and the Cia. Metalurgica Peñoles. Ores, which come from a variety of sources, include almost all the mineral producing areas of Mexico. They vary greatly in content and richness but most of them can be classified as lead ores with small amounts of silver, gold, copper and sometimes arsenic, bismuth, antimony and other metals. The principal product is lead, which is sold in various foreign markets, the gold and silver was sold until recently to the Bank of Mexico for resale to the United States. The smelters are charged with sinter, ore, limestone from the local quarries and iron ore from Durango, coke from Sabinas. The lead bullion is drained off at the bottom, the matt and slag taken off at higher levels; the lead goes to the refineries which also receive bullion from smelters in other localities. Gold and silver are purified by electrolytic methods. The Peñoles plant produces daily about 200 tons of lead, 1 ton of silver and 15 kilograms of gold.

The Ladrilla Monterrey is located at the foot of La Silla in the southeastern part of the city, just beyond the city limits (fig. 4). The principal products are common red bricks, hollow tile for building walls, roof and floor tile, the last two glazed and unglazed. In addition decorative tile is made in comparatively small quantities. The clay, obtained from the river flood plain near the factory, has an overburden of two or three feet of grayish black soil, with numerous limestone pebbles. Below this is a nearly uniform deposit of brown clay (B horizon) from ten to twelve feet thick, underlain by coarse gravel. For the finer glazed tile, clay is imported from Texas, as is also the glazing material. The ceramic industry is especially important in Monterrey on account of the scarcity of wood.

The three glass factories, established in 1917, obtain their raw materials from Texas; sand at 18 pesos and soda at 140 pesos per ton. There is very little tariff on the raw material, about 1.5 centavos per kilogram on the soda, but a heavy duty on the competing products of foreign origin. One of the plants makes flat glass, another bottles, the third table ware of all kinds. There are a few other small plants in the City of Mexico, Puebla and Guadalajara, but the relative production favors Monterrey. Not only do these plants take care of domestic needs but export to Middle and South America, especially to Colombia and Venezuela, meeting competition from Germany and Japan. The value of the production of flat glass is about 3,000,000 pesos annually.

The furniture industry is third in Monterrey from the standpoint of persons employed. There are four large factories and about twenty small shops, all within the city proper, using woods derived largely from the United States. Southern Mexico produces a number of good cabinet woods but

little reaches Monterrey and the nearby forests supply only a small quantity of the cheaper woods.

The Cuauhtémoc Brewery, one of the most important industries in Monterrey, is located in the north-central district on the street of the same name. The brewery employs from 500 to 1000 persons, depending on the volume of business and is capable of producing one million bottles and 18,000 kegs of beer in 24 hours. The malt is produced locally from Baja California barley, but most of the hops is imported, mainly from Bohemia, California and Washington. The market includes all Mexico, Central America, Cuba and the United States.

La Moderna cigarette factory began operation in 1934 and now has 350 employees, with a production of 8,000,000 cigarettes per day. Most of the tobacco comes from the vicinity of Tepic in Nayarit, some from Veracruz, only about 10% from Nuevo León. The factory is modern with machines of 1,000 per minute capacity. Six brands are produced ranging in price from 5¢ to 20¢ (centavos) per package. Only one third of the market is in northern Mexico, the remainder in the Federal District and southern Mexico. Two other factories in México, D.F., are the principal competitors; there are also several small factories in Monterrey.

In addition to the large factories which lie largely in the industrial belt there are at least a hundred smaller establishments, some of them home industries. There are also many shops of strictly local importance such as bakeries, print shops and the numerous shops connected with retail stores. Many of the smaller manufacturing establishments are found in the patios of very respectable dwellings and only the hum of a motor or the arrival of a truck load of raw material marks their location.

AREAS TRIBUTARY TO MONTERREY

In northeastern Coahuila, northern Nuevo León and northern Tamaulipas there is little doubt of Monterrey's commercial supremacy: there is no rival either in manufacturing or trade. This area includes parts of four physical regions: the Sierra Madre, the Piedmont, the Coastal Plain and the Lower Rio Grande Valley (fig. 1). The Piedmont is easily the most important since it contributes more raw material than the others and absorbs more of the manufactured products; it is also the most densely populated (fig. 13). The Lower Rio Grande Valley is of potential importance especially as irrigation is introduced, but the narrow Coastal Plain is sparsely settled and of little significance to Monterrey.

To the south only a small part of the Sierra Madre is commercially tributary to Monterrey; the southern part of Nuevo León finds more ready

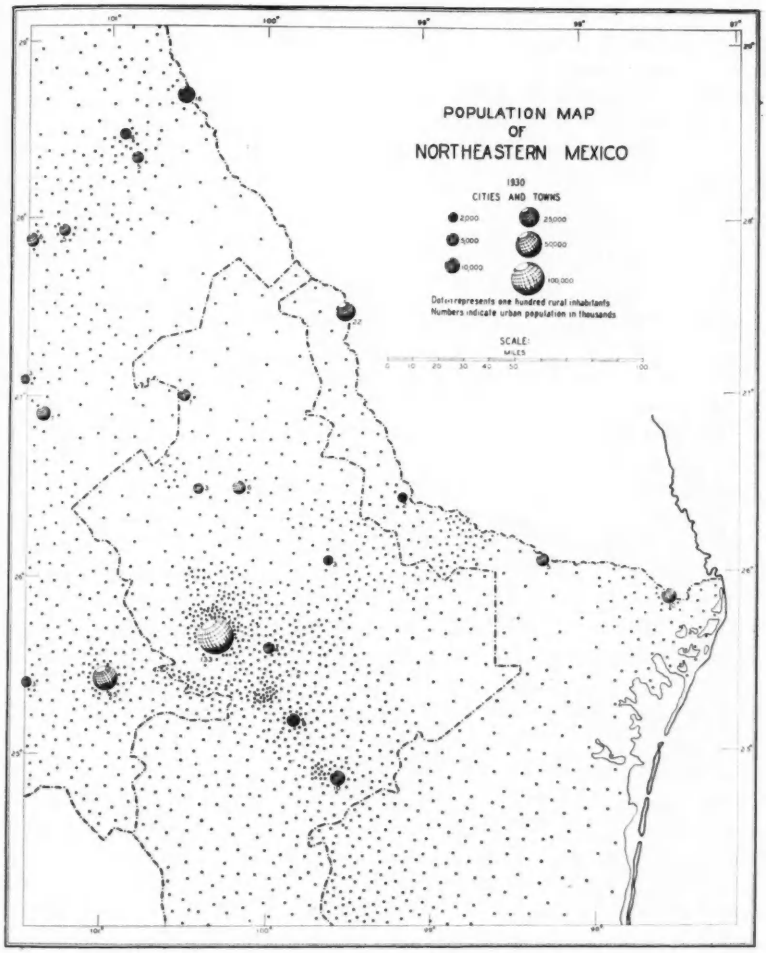


FIG. 13.—Population map of northeastern Mexico, 1930. The data are by *municipios*, many of which are large, and the concentration of population along streams is not indicated. There is a noticeable concentration in the Piedmont near Monterrey as compared with the northern and eastern Piedmont, and the Coastal Plain.

outlets to Saltillo, Matahuala and San Luis Potosí.[13] However, recent road building is making more of this territory turn to Monterrey, where formerly

[13] Dicken, S. N.: "Basin Settlements of the Middle Sierra Madre Oriental," *Ann. Assoc. Am. Geogrs.* 26 (1936), 178.

the easier routes led to Saltillo or San Luis Potosí. On the steep front of the Sierra there is little activity save for a few mines, some of which have recently ceased production. A notable exception is the iron mines at Rinconada between Saltillo and Monterrey, close to transportation. Otherwise the southern sierran front is chiefly important in supplying abundant water for the needs of the city.

To the north the Sierra takes on a very different aspect. The ranges are separated by broad alluvial valleys many of which produce corn and fruits. Transportation is comparatively easy northward and southward, and gaps in the ridges afford outlets east and west. The ranges, lower than their southern components, furnish lead ores, iron, shale and limestone for cement. Since the northern Sierra is so accessible from Monterrey and the principal rail routes lead to the northwest, a large part of northeastern Coahuila comes under the commercial influence of Monterrey rather than Saltillo.

The Piedmont, the most productive region in the vicinity of Monterrey, extends from the Rio Grande southward along the Sierra Madre, but only the northern part is of immediate concern to Monterrey (fig. 1). This is a typical front range piedmont,[14] a broad fluviatile apron, spreading from the mountain base to the Coastal Plain. It is dissected, but not deeply, by streams with narrow flood plains. The gravel-capped interfluves may be described as mesas or as plains according to their size. Here and there are low hills, outliers of the Sierra Madre. The surface material is usually gravel consisting largely of limestone fragments, less often of silt; in the river banks the alternation of gravel and silt is usually apparent. The surface layer is more or less indurated and weathered to a thin but fertile black soil.

As stated at the beginning, the Piedmont is apparently sparsely populated. In reality there are numerous settlements along the streams, which depend on irrigation for the production of corn and sugar cane and smaller amounts of wheat, oranges, beans and cotton. The streams with their steep-walled banks are a hindrance and communication in many parts is very poor. In the rainy season the roads are muddy, in the dry season dusty and rutted so that the exposed boulders present a distinct hazard for automobiles and trucks. Thus many of the towns are not effectively connected with Monterrey. A few detailed descriptions will indicate the varying quality of this northern Piedmont.

The cultural heart of the Piedmont is in the vicinity of Monterrey and to the southward. It is the most humid and since it borders the highest part

[14] Most descriptions of northeastern Mexico have included the Piedmont in the Coastal Plain. See, for example, Sanders, E. M.: "The Natural Regions of Mexico," *Geog. Rev.* 11 (1921), 212-216.

of the Sierra, the water supply is greater and more constant. Immediately to the south of Monterrey is the Huajuco Valley, a structural trough 20 miles long between the main range of the Sierra Madre and the Cerro de La Silla. It resembles an Appalachian valley in structure and in the rolling hilly nature of the bottom and the scarcity of alluvium, but culturally it is part of the Piedmont. Within the valley there are three low parallel ridges of shale which trend with the structure. The first is a continuation of Loma Larga, which turns southeastward, crosses Huajuco Valley diagonally and merges with the foothills of La Silla. A similar ridge emerges from the Sierra and continues southward, crossing to the east side at the mid-point of the valley. A third ridge follows the same pattern and breaks up into a hilly belt at the south end of the valley where the dip flattens out. Between these shale ridges the rolling floor of the valley reveals alternate outcrops of shale and gravel; on the gravel corn, beans, sugar cane and oranges are produced; the shale areas covered with chaparral are good only for goat herding. At the southern end Huajuco Valley is closed by a broad mesa; beyond and below lies Allende.

Allende is located on an abandoned river flood plain and a low mesa (fig. 14). It lies close to the mountains, at the mouth of a canyon where the Rio Ramos, fed by numerous springs, supplies sufficient water to irrigate the flood plain, a mesa, and an abandoned channel of the river. Several irrigation ditches are easily diverted from the river by small rock dams within the canyon. Most of the land on both sides of the Loma de La Silla (fig. 14) is in citrus; corn is second, cane a poor third in acreage. The cultivated mesa to the east is at the same level as the broad mesas near Montemorelos. In the canyon the corresponding terrace is strongly indurated, showing 20 to 50 feet of conglomerate, but even here small patches are cultivated, many of them in citrus. The natural vegetation in the canyon includes water cypress, live oak, sycamore and walnut.

Montemorelos is about 50 miles southeast of Monterrey on the Rio Pilón, and is the most important citrus producing district of Nuevo León. It is several miles from the canyon and water can easily be brought out on the wide flood plain, a typical site along the eastern front of the Sierra Madre. A band varying in width up to 10 miles, and extending about 25 miles along the river, is irrigated by the waters of the Rio Pilón. Surrounding this basin-like area are the shale mesas, capped with limestone conglomerate, too high to be irrigated but their chaparral vegetation is a source of wood, and provides pasturage for goats. Although there are several large citrus groves in the vicinity, ranging from 5,000 to 20,000 trees, the bulk of the production is in smaller units. Production includes navel and valencia oranges, grapefruit and limes. Most of the product is shipped to

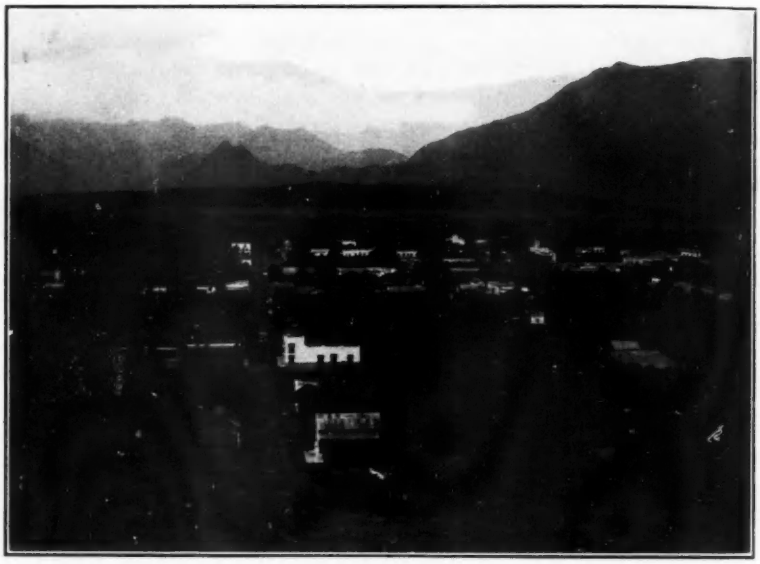


FIG. 14.—The town of Allende from the summit of the ridge on the east—the Loma de Silla.

Located on a small mesa at the mouth of a canyon, Allende is typical of many towns along the margin of the Sierra Madre.

the City of Mexico, Monterrey and other cities in Mexico, by truck and rail, as bulk oranges. A small amount is graded, boxed and exported to Canada and Germany. There are many nurseries and other evidence of rapid expansion of the citrus acreage, especially in grapefruit. This expansion is probably stimulated by the expropriations of land under the agrarian law, since land in commercial tree crops is exempt; consequently there is grave danger in the next few years of over-production, unless new outlets can be obtained. This citrus district like others in Mexico, is handicapped by the failure to produce good quality fruit in the summer season. Much of the winter fruit is of high quality and should find a ready market abroad. The other important crops in the vicinity are corn and sugar cane, both for local consumption.

North of Monterrey the Piedmont contrasts rather sharply with the Allende-Montemorelos portion: there is less rain, few streams for irrigation, production is more specialized and includes coal and cotton both of which are important to Monterrey. The coal fields of northeastern Coahuila include two structural basins, one in the vicinity of Sabinas and Nueva Rosita,

and another a few miles to the south. The first, in operation on two sides of the synclinal basin, produces about 700,000 tons of coal annually, most of which is converted on the spot into coke to be used in the various smelters of northeastern Mexico. There are two main beds, four feet and two and one-half feet respectively, separated by a layer of shale. Due to the rather strong dip and the structural weakness of the coal, there are many difficulties in mining, including that with water. Under present conditions not more than 60% of the coal can be recovered. The reserve is estimated at 65,000,000 tons. The other field, at Lampazitos about 30 miles to the south, is relatively inactive since it does not produce a coking coal. The coal is harder than that of the Sabinas areas and is more satisfactory for fuel, but only a small amount is used for locomotives in the vicinity of the mines since most of the Mexican railroads use oil. However, the Mexican Southern Pacific uses coal from this field on its line between Guadalajara and México, D.F., as does also the National Railway on freight trains between Monclova and Piedras Negras. The high freight rates to the Federal District (14 pesos per ton), effectively prevents the use of coal for domestic purposes. At current prices there is little or no demand for coal in any part of Mexico. Charcoal is used widely, also wood and, in a few cities, natural gas. Although coal is not used in Monterrey for domestic purposes, both coal and coke are available at a reasonable price for manufacturing.

In the northern Piedmont agriculture is less important than in the south. The limiting conditions are indicated by a description of the Don Martín cotton district, the youngest in Mexico.[15] It lies on a series of gravel-capped mesas where the Rio Salado crosses the Coahuila-Nuevo León boundary. The rainfall is light and before the construction of the dam there was little agriculture; the land was used for grazing. The reservoir with a capacity of more than a million cubic meters is capable of irrigating 100,000 acres but only a portion is actually under ditch. Into this district which was formerly sparsely settled, many colonists were introduced, including repatriated agricultural workers from the United States. Cotton was the principal money crop from the beginning, and in addition small quantities of corn, wheat, beans and alfalfa. It is the intention of the governmental agencies sponsoring the project to make it self-sustaining as far as possible, and that eventually enough corn, wheat and vegetables will be produced for food, and enough alfalfa so that a livestock industry can be established. The problem is similar to that of the Cotton Belt in the United States but even more difficult because of the additional hazard introduced by irrigation. In December, 1937, the reservoir was nearly empty and in many fields alkali spots were beginning to appear.

[15] Dicken, S. N.: "The Cotton Regions of Mexico," *Econ. Geog.* 14 (1938), 368.

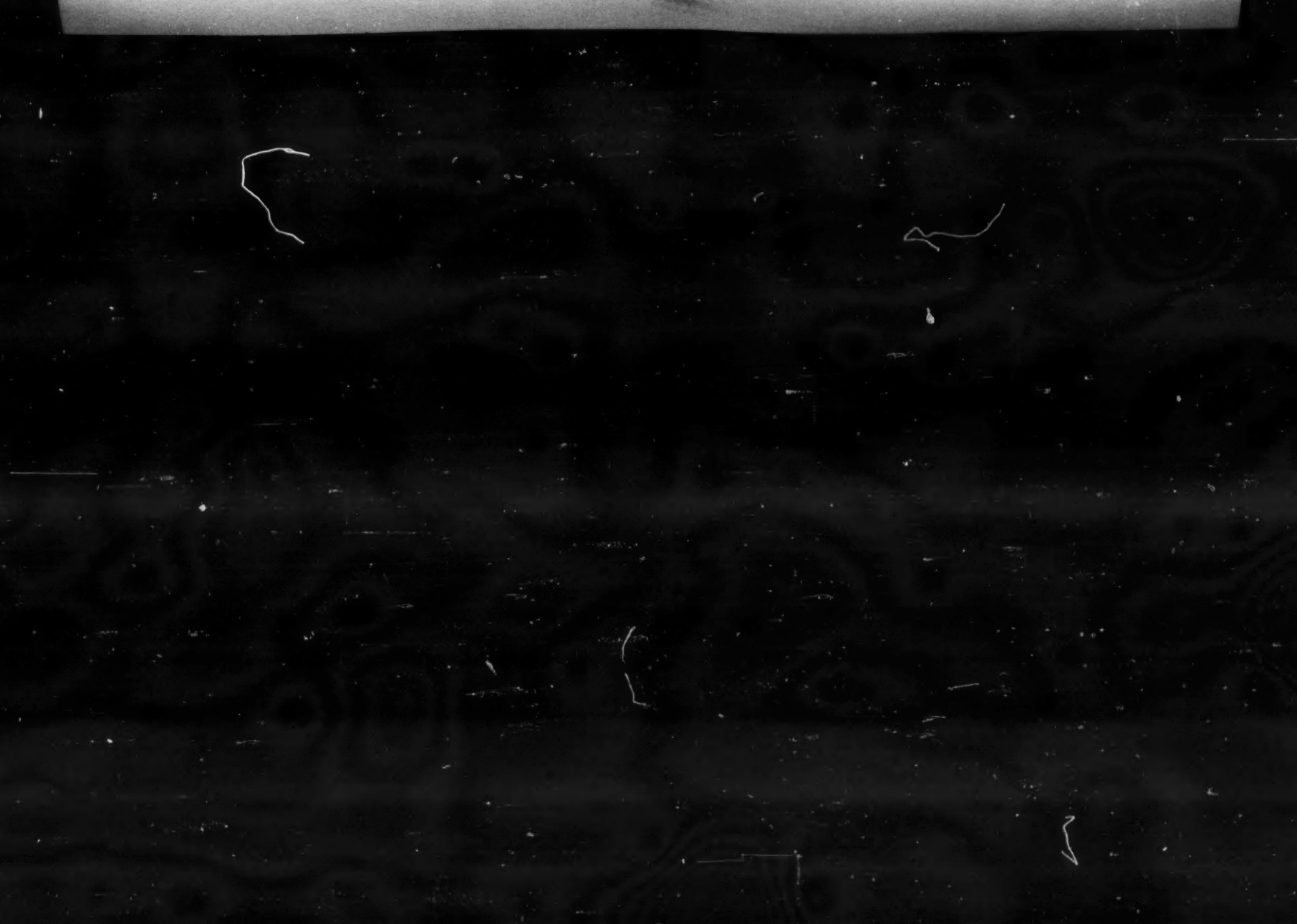
There are hundreds of small settlements in the Piedmont, each of which produces a small amount of corn, sugar, beans, vegetables, cotton and oranges. The population map (fig. 13), based on data by *municipios*, scarcely brings out the pattern of these settlements. They are located, almost without exception, on the principal rivers and their tributaries where water is available, and where smooth flood plains can be cultivated. Simple diversion ditches bring the water to the fields of corn and sugar cane, and a surplus of both are produced. Indeed Nuevo León as a whole produces a small surplus of corn, but the production of cane has declined somewhat in recent years. However, it is more important farther south. The through routes, rail and highway, use the flat mesas between the rivers and miss most of the Piedmont settlements.

The south side of the Lower Rio Grande Valley, potentially the most fertile and productive region in Monterrey's hinterland, is strikingly underdeveloped. There is almost no large scale irrigation and a limited amount of dry-farmed cotton is its principal contribution. The flood plain slopes away from the river, which is entrenched about 20 feet, and it is necessary to pump the water over the natural levee in order to irrigate the flood plain. However, no pumps have been installed. The Mexican side of the Valley could be as prosperous as the United States side, were there a market for its products. Instead, the broad flood plain is covered with bunch-grass, chaparral and cactus, except for a few areas near the towns. A dam is under construction in the San Juan River, however, which will irrigate about 140,000 acres, much of it in the Rio Grande Valley. It is considered more feasible to irrigate by gravity from a tributary than to pump directly from the Rio Grande. Although this project, when completed, will increase the production of cotton in Monterrey's hinterland, there is little possibility of other crops becoming successful unless the United States tariff is lowered, thus providing a market.

Monterrey's immediate hinterland is far from being as unproductive as it seems. It produces a surplus of corn and oranges (in addition to Monterrey's consumption), something less than enough sugar, wheat and meat. The most significant raw materials are coal and cotton, both of which are adequate. But to find the basis of an industrial city, the size and importance of Monterrey, it is necessary to look beyond, to the remote hinterland.

THE REMOTE HINTERLAND

The remote hinterland of Monterrey may be defined in terms of the origin of raw materials and the location of markets. It is true that many of the industries of Monterrey, such as ceramics and cement, obtain the bulk of their materials near the city, but nevertheless many important industries



are dependent on distant sources for raw materials. That Monterrey should reach out so far for raw materials may be an indication of the undeveloped state of modern industry in Mexico, but it also shows the advantageous position of the city.

The cotton textile industry is a special case and by no means a conclusive one. Monterrey does not rank high as compared with the older centers of industry, such as Puebla, the City of Mexico and Veracruz. Furthermore, there is an abundant supply of raw cotton at Don Martín and Matamoros to which Monterrey has easy access. Nevertheless, because of the demand for certain qualities of fiber, 45% of Monterrey's raw cotton comes from the Laguna district (Torreón).[16]

The industry which has contributed much to the growth of Monterrey and which is most dependent on the remote hinterland, is metals. During the period of early growth there were a number of small mines operating on Las Mitras, La Silla and at El Diente, a few miles south of the city; the last named ceased production only recently. Somewhat farther were the mines of Cerralvo, Iguala and San Carlos and many other smaller mines produced lead ores with small amounts of silver and gold. Without overlooking the importance of these early mines in the development of the smelters and refineries in Monterrey it is well to point out that the city is in a good position to receive the ores from remote mines and export the products.

Today Monterrey gets its ores, concentrates and bullion from many parts of Mexico, in fact from all the mineral producing areas except the northwestern part, Sonora and Baja California. Of the 20 states of Mexico producing lead ores, Monterrey receives shipments of ores, concentrates or bullion from 12, including southern states, such as Oaxaca and Guerrero.[17]

In lead refining Monterrey has a practical monopoly. In 1932 the American Smelting and Refining Company produced 89,728 metric tons of refined lead, the Compañia Metalurgica de Peñoles nearly 27,000 tons. The total production for the entire country was only 137,000 tons.[18] It can be pointed out that this dominant position is due largely to the enterprise of the companies operating in Monterrey and to their far-flung system of smelters, but that is not to detract from the advantageous position of Monterrey with respect to export, coke and natural gas.

[16] Boletín Mensual de Estadística Agrícola, Direccion de Economia Rural, No. 120 (May, 1936), 517. México, D.F.

[17] Anuario de Estadística Minera, *loc. cit.*

[18] For 1937 the unofficial figures give the American Smelting and Refining Company 140,000 tons, the Compañia Metalurgica Peñoles 70,000 tons and the total for the country 231,000 tons.

CONCLUSION

Monterrey is the dominant urban nucleus of northeastern Mexico for a number of complex and interrelated reasons. Some of these factors are material and permanent, others are immaterial and transient. On the one hand is the favorable situation with respect to transportation and certain basic raw materials, including water, coke, iron ore and natural gas. Another factor is the immediate agricultural regions which supply the common food materials and a number of other articles. On the other hand the nearness to the United States was, and continues to be, advantageous. The availability of certain raw materials coupled with a strong protective tariff has been favorable to Monterrey. Northern capital is an advantage which is fast disappearing, perhaps because it is no longer needed. It is not too much to assert, in brief, that Monterrey's growth and importance springs from a favorable situation, exploited by foreign capital at the invitation of Governor Reyes. There are other factors, to be sure, such as the business enterprise of the people and the fact that intimate contact with the United States has made them more familiar with modern products and techniques. The future of Monterrey is dependent on two sets of related circumstances. If the industrial progress of Mexico continues the city is prepared to retain its position of leadership. Further progress, however, will produce rivals and Monterrey may find its remote hinterland curtailed. But there is no denying that it has an initial advantage and momentum which will make it difficult to supplant.

University of Minnesota,
February, 1939.

The Pack-Ice of the Weddell Sea*

WILLIAM H. HOBBS

The so-called Weddell Sea in the Antarctic is one of the two indentations of the continent, and lies to the east of Palmer Land and west of Coat's Land. It is a major feature of the earth with length of about 700 miles and breadth about 1200 miles.

This great sea appears to have been first penetrated by Captain N. B. Palmer in 1822 off the east coast of Palmer Land and between the meridians of 58° and 60° west. This penetration was to 66° south latitude, and perhaps to 68°.[1] A month earlier (December 13, 1821) in company with the English sealer Powell, Palmer in an attempt to push south near the 46th meridian had been halted by impenetrable pack in latitude 62° 25′ S. This point was to the southward of the South Orkney Islands, or near the central axis of the sea.

All subsequent explorations of the sea from Palmer's day to our own, even when explorers have been equipped with powerful steam whalers, have conclusively proven that the central and western portions of this great sea are occupied by impenetrable pack, which is generally surrounded on north, west, and east by loose to heavy pack. Only after terrific katabatic winds have rushed down from the inland ice which borders the sea, is its surface open in lanes located near the shore.

While these strong winds of the glacial anticyclones are sufficiently

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* *Editor's Note.*—This paper deals with the theme presented orally by Professor Hobbs at the Cambridge, Massachusetts, meeting of the Association of American Geographers in December, 1938, and abstracted in these ANNALS, 29 (1939), 75–76. It is, moreover, an amplification of material published by the author in his recent monograph, "The Discoveries of Antarctica within the American Sector," cited in footnote 1.

After the paper here published had been read in proof, a letter from the eminent British geographer, Dr. Arthur R. Hinks, was handed to the editor. This letter remonstrated against publication of the abstract and listed seven categorical criticisms of its contents. These items the editor forwarded to Professor Hobbs, with the request that he make reply to each of the points at issue.

Dr. Hinks's seven criticisms are published in full at the end of the paper, together with Professor Hobbs's rejoinders.

[1] W. H. Hobbs, The Discoveries of Antarctica within the American Sector, as Revealed by Maps and Documents. Trans. Amer. Philos. Soc., N.S., vol. XXXI, Part I, January, 1939, pp. 31–32.

powerful to force the pack away from the shore, they at the same time bring out snow measured by the millions of tons and at very low temperatures. This, added to the sea water, causes it to congeal quickly when the relatively warm blizzard has been succeeded by the cold calm. Alternation of blizzard with calm thus has the effect of producing sea ice during the calm, which is drifted northward away from the shore during the succeeding blizzard, which in its turn may open another lane off shore. Thus a halting and staggering advance with direction depending upon whether the storms from the southeast or the south and southwest are the stronger, the pack moves away to the northward, where on its northern border it is eventually melted in the warm rains and broken up by the swells to be dissipated and destroyed.

It is the operation of these Antarctic blizzards coming off the inland ice which in other areas more favored, such as the Ross Sea, supply the wide off-shore lanes of open water which alone permit extensive navigation of the Antarctic during its summer season. Similar conditions within the Arctic are found off the inland ice of Greenland in Melville Bay, which is adjacent to the only considerable stretch of shore lacking an intervening ribbon of land to separate it from the inland ice. Hence, Melville Bay in the Arctic furnishes the only parallel to the borders of the Antarctic continent. Unlike the Weddell Sea, Melville Bay is merely a broad and slight indentation of the coast.

In 1823 James Weddell, retired Royal Navy captain, took up sealing for the Enderby's. He claimed to have penetrated the Weddell Sea near its central axis to the extreme southern latitude of 74° 15′ S, *all the way in open water both going and returning. No pack ice was seen but only icebergs.*[2] In the book in which he described this alleged cruise he printed a map of the Shetland Islands which he claimed to have produced from his own surveys, but as he cruised only off the north shores of the islands and generally at a considerable distance, it is clear that his map was copied from a suppressed map accessible only in the office of the Admiralty, a map which had been made by Captains Palmer and Powell before 1822 and published in that year.[3] He also set up a false map of Antarctic land. When therefore he claimed to have completed a cruise under conditions so different from those encountered by others within the same region, it calls for very

[2] James Weddell, A Voyage Towards the South Pole, Performed in the Years 1822–24, Containing an Examination of the Antarctic Sea to the Seventy-Fourth Degree of Latitude; etc. London, 1825, pp. iv and 276, maps and plates. Second edition in 1827.

[3] William H. Hobbs, The Discoveries of Antarctica within the American Sector, as Revealed by Maps and Documents. T ans. Amer. Philos. Soc., N.S., vol. XXXI, Part I, January, 1939, pp. 39–46.

special examination and evaluation, the more so since his name has by the British Admiralty been given to the sea he claimed to have penetrated. The only other skipper who has claimed to have penetrated the Weddell Sea by sailing through it and in the area of Weddell's cruise is the American sealer Morrell, who was a notorious braggart and whose claims have quite generally been discredited.[4] There are many others who have attempted it, but none has succeeded in navigating it. Some have been beset and willy-nilly have slowly drifted through it, imprisoned in the ice for months. Weddell claimed to have *sailed in open water all the way both going and returning.*

The great French explorer Dumont D'Urville in 1838 attempted to repeat Weddell's cruise, and after reaching latitude 63° S, on Weddell's supposed track, he retired to his bunk expecting to be in latitude 65° S by noon of the following day. Instead of this he was routed out at three in the morning to look out upon a vast area of impenetrable pack. His comment was:

"Without disputing definitely the truthfulness of the narrative of Weddell, I am obliged to hold myself in cautious doubt until another attempt is made by a trustworthy navigator. As soon as another captain has been able to go 5 or 6 degrees farther south than we, any doubt will cease and Weddell will have complete right in my eyes."[5]

Five years later Sir James Clark Ross, compatriot of Weddell, made a second attempt to repeat this cruise, only to be stopped by impenetrable pack in latitude 65° 13′ S, nine degrees of latitude, or more than 600 miles short of Weddell's farthest. This was his comment, "He (Weddell) was in a clear sea: we found a dense impenetrable pack. . . ."[6]

In November 1894 Larsen in the *Jason* found the margin of impenetrable pack to lie in this region between 63° 15′ and 64° between the longitudes 47° 30′ W and 55° W. This margin he skirted, at times tieing up in bays of the pack-ice margin.[7]

Still again in 1902 Nordenskjöld with Larsen as his skipper made another attempt to follow on Weddell's track, only to find the same impenetrable pack near where Larsen had found it eight years before.[8]

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[4] Benjamin Morrell, A Narrative of Four Voyages to the South Sea, North and South Pacific Ocean, Chinese Sea, Ethiopic and Southern Atlantic Ocean, Indian and Antarctic Ocean. From the Year 1822–1831, New York, 1832.

[5] M. J. Dumont D'Urville, Voyage au Pôle Sud et dans l'Océanie sur les Corvettes l'Astrolabe et la Zélée, etc., vol. II, 1842, pp. 47–48. See also A. Schück, Verhandl. d. Ver. f. Naturw. Unterh., Hamburg, vol. V, 1882, pp. 118–128.

[6] Sir J. Clark Ross, R.N., A Voyage of Discovery and Research in the Southern and Antarctic Regions during the Years 1839–43, vol. II, p. 357.

[7] The Voyage of the "Jason" to the Antarctic Regions (Abstract of Journal kept by Capt. C. A. Larsen), Geog. Jour., vol. IV, 1894, p. 335.

[8] Nordenskjöld and Andersson, Antarctica, Macmillan, 1905, pp. 80, 88, map at end.

Let us now consider the experience of other explorers who have attempted to navigate in the Weddell Sea. In the years 1911–12 the German explorer Filchner in the barque *Deutschland* with auxiliary engine of 300 horsepower, made his way southward in the pack under great difficulties along a course about twenty-five miles to the eastward of Weddell's alleged southward course. After reaching latitude 61° S, Filchner was continually surrounded by pack, sometimes loose, sometimes so heavy as to leave his ship beset. To advance the 1000 miles to reach the coast in latitude 78° S occupied six weeks. He was thereupon firmly beset in the pack and slowly drifted northward in it not far west of Weddell's returning track, and after ten and one-half months of imprisonment, his ship was set free[9] (Fig. 1).

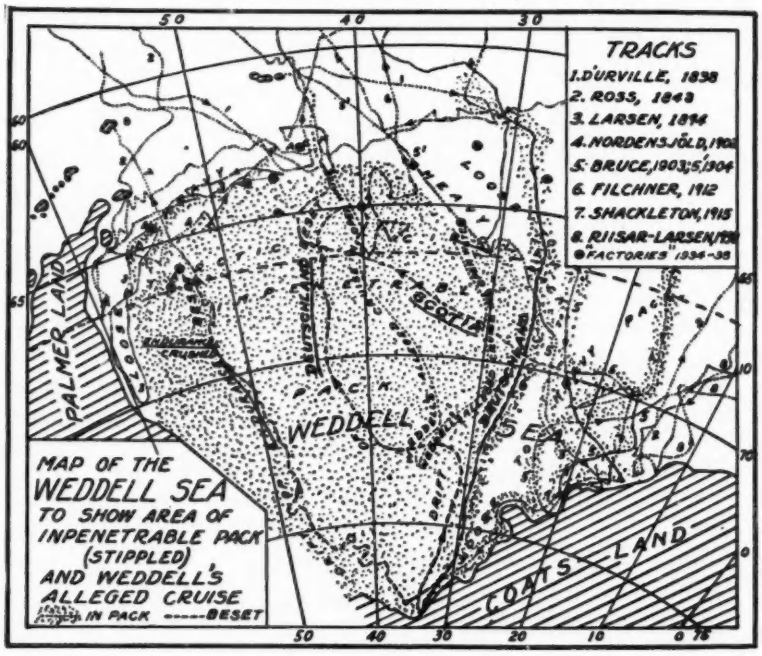

FIG. 1

A summary of Filchner's log for the southward cruise in the pack before the ship was firmly beset, is of much interest:

[9] Wilhelm Filchner, Zum Sechsten Erdteil, Die Zweite Deutsche Südpolar-Expedition, Berlin, 1923, pp. 410, map opposite page 145.

December 14, 1911. Entered sea ice in latitude 58°. Blocks of ice of average thickness of 1.3 to 1.5 meters. (His Fig. 42 shows the close character of the pack.)

December 15–17. Sailing through loose pack which had to be rammed. Made 200 miles advance in three days. (Fig. 44 shows the character of this pack.)

December 17. Pack became compact.

December 18. Drifted 6 miles to the eastward. Latitude near 61°.

December 19–21. Could make only 20 miles advance during these days. On the 19th was near Weddell's route. For safety the ship had to be anchored to the pack ice where it became beset and nothing could be done to save it from its fate.

December 21. The pack broke up into great floes during a storm. Floes piled up to height of 5 meters.

December 22–23. Were able to advance only 60 miles in two days—50 miles in first day, 10 in second.

December 24–30. Drifting in the ice and pushed back to the northward 11 miles. Between 17th and 31st December was set back 31 miles. On 27th some water sky was seen with latitude 61° 59′.

December 31. Still heavy pack jammed together. On this day was farther north than 9 days earlier on account of the ice drift.

January 1–3. Advanced 60 miles in three days, then the pack closed so tight that ship could not move. Being pushed still farther north.

January 4–6. Pack is still heavier. Its thickness in places is 3.7 meters. It is noteworthy that up to this point no icebergs frozen into the pack have been seen. Latitude is now near 64°.

January 7–8. Beset in spite of much effort to get free.

January 9–10. Ice appears porous and near a breakup. Ship is free and through leads in the ice made 18 miles of latitude and 10 miles of longitude.

January 11. Passed the Antarctic circle. Advanced in open pack. Icebergs seen. Advance 107 miles.

January 12. Made 113 miles to the south through broken pack. Latitude 67° 27′ S.

January 13. Great surfaces of open water. Everyone cheerful. Passed latitude 69° S.

January 14–15. Less satisfactory outlook. Pack ice getting all the time heavier and the leads narrower. In the last 24 hours advanced 64 miles.

January 16–17. Made some headway. 48 miles in a south-southwest direction. This headway made by ramming, etc. On the 17th blocked by great field of pack ice.

January 18. Beset in heavy pack. A lead later opened and ship advanced 51 miles to the southwest.
January 19. Beset in heavy pack with hummocks.
January 20. Beset.
January 22. Still beset.
January 23. On the same spot as yesterday.
January 24–25. Ship advanced 3–4 miles and in the last three days 16 miles.
January 26–27. Still beset.
January 28. Began ramming the pack. Advanced 48 miles.
January 29. Reached 74° 16′.
January 30. Sighted land, Luitpold Coast. Better going. Skirted the coast of the barrier ice in latitude 77° but at times beset. Ship had now been in pack for 47 days. On March 5th the ship became firmly beset and drifted north in the pack for ten months, to be freed on December 16, 1912 when in latitude 60° S.

Three years later, in 1915, Shackleton in the *Endurance* through steering close to the Coats Land coast was able to make his way southward through the pack to much the same southing as Filchner, but only like Filchner to have his ship beset. Drifting northward in the pack the *Endurance* was crushed and sunk near latitude 68°, after which the crew with whaleboats continued to drift on the ice until finally set free.[10] The summarized history of the southward cruise before the ship became firmly held in the ice is of great interest:

December 7. Ship entered pack in latitude 57° S. In latitude 58° 28′ there is loose ice on fringe of pack.
December 8–11. Loose open ice. Entered pack again in latitude 59° 46′. The pack extended far to the east.
December 12. Sailing first through loose pack, later thick pack.
December 14. Conditions harder. Pack denser.
December 15. Pack extends in all directions. Latitude 61° 31′.
December 16. Leads of open water.
December 17. The ice is difficult again. Ran only 32 miles in 24 hours. Latitude 62° 12′.
December 18. Among large floes. The leads are few.
December 19. Conditions did not improve. Ship stopped by floes. Latitude 62° 42′.
December 21. Advanced through the pack, making 7 miles in forenoon.

[10] Sir Ernest Shackleton, C.V.O., South, The Story of Shackleton's Last Expedition 1914–1917, London, 1919, map at end of volume.

December 24. Made 70 miles in 24 hours. Latitude 64° 32′. Heavy floes held up the ship.
December 25. Made 71 miles through opening and closing leads.
December 27. Latitude 65° 43′.
December 29. By the drift of the pack the ship was pushed eleven miles north of its position on the 25th.
December 31. Ship has been in serious ice pressure. Latitude 66° 41′. Later the pack improves—is more rotten. In 20 days since entering the pack on December 11 "have come 480 miles through loose and close pack ice."
January 1. Pack improved, but later blocked the way.
January 3. "Made 11 miles to the south." Latitude 70° 28′. Impenetrable pack to the south and the east. Further effort seemed useless.
January 6. Solid pack barred our way to the south.
January 8. Noon position 70° S. Floes looser. Better conditions near the land as ship advanced southwestward, though it became firmly beset on January 18.

One other ship has crossed the region of Weddell's alleged cruise—the powerful steam whaler *Scotia* commanded by Captain Bruce. On February 22nd, 1903 this ship became beset near latitude 70° S, longitude 20° W. Thus held firmly in the pack the ship crossed Weddell's two tracks. On this Brown comments: "Crossed Weddell's track, but under very different conditions from those experienced by him, for while he was favored by open sea, we had the impenetrable pack under our lee." The summarized log of this drift for the southward cruise is very interesting:[11]

February 2. Heavy pack in latitude 60° 28′ S.
February 3. Pack closed in. Steamed north.
February 4. Steamed through pack.
February 5. Pack became very close. Turned north. Ice blink all around horizon. Steamed through 80 miles of ice.
February 7. Through much ice.
February 10. Beset in ice.
February 13. For some days went east along edge of heavy pack toward the south.
February 14. A loose pack and so able to steer south again.
February 15. Almost clear of pack ice. This is near the Antarctic circle.
February 18. Clear of ice.
February 19. Pack ice again.

[11] Rudmose Brown and others, The Voyage of the "Scotia," being the Record of a Voyage of Exploration in Antarctic Seas, by Three of the Staff, London 1906, pp. 51, et seq.

February 20. Increased tightness of pack. Had to dodge and steer east. Made but little southing.

February 21. Slow progress. Passed 70° S. Approaching the land.

February 22. Pack cemented together.

February 28. During last six days have had a hard battle with the ice, which on many occasions threatened to hold us fast for the winter. This is well to the east of Weddell's track. On the 24th tried ramming the ice but without success. On 25th were beset but leads opened. On the 27th occasional areas of open water.

March 1. "Crossed Weddell's track, but under very different conditions from those experienced by him, for while he was favored by open sea, we had the impenetrable pack under our lee."

March 4. Lay to all day.

March 19. During the past fortnight have continued to sail or steam in a northwest direction. On 8th were driving before a heavy easterly gale, but had collision with a heavy floe. On the 13th much heavy ice about (near Antarctic circle). On the 17th got into open water.

March 21. Orkneys were sighted.

Thus it is clearly to be seen that at least in the years 1822, 1838, 1843, 1894, 1902, 1903, 1904, 1912 and 1915 the central area of the Weddell Sea was even in the summer season an area of impenetrable pack within which there was in general a strong northerly to northwesterly drift in which even steam vessels were nearly helpless. Even in the eastern third, where conditions are better, all vessels navigated in pack ice which has varied from loose to heavy, and in which progress has been made by maneuvering through leads, when these could be found, or by ramming the ice where it was either thin or rotten. The *Scotia* alone in the summer of 1904 was able without difficulty to proceed southeastward from the South Orkneys to near the Antarctic circle, where not far from Weddell's southward track the ship was forced by the pack to steer northeastward. Thereafter by keeping more to the eastward the ship was able to reach Coats Land under sail alone. However, the zoological log of the vessel on this cruise records that the pack was entered at 7 a.m. of February 26 in latitude 65° 59′ S, longitude 33° 06′ W, and the map II shows that the pack ice was in sight all the way except for a stretch of 50 to 75 miles between the latitudes of 69° and 70°.[12] In this loose pack the *Scotia* encountered no "obstacle." The return journey was made near the coast of Coats Land without special difficulty.

The northern borders of this broad sea have recently been frequented

[12] William S. Bruce, Report on the Scientific Results of the Voyage of the S.Y. "Scotia" during the Years 1902, 1903, and 1904. Scot. Natl. Ant. Exped., vol. IV. (Zoology), map 2.

each southern summer by the great "floating factories" of the Norwegian whaling industry. These ships in pursuit of the whales go as far to the south as the nature of the pack permits. The extreme southings of nine of these vessels for four successive seasons, 1934–35, 1935–36, 1936–37 and 1937–38 (see black spots of fig. 1), therefore indicate roughly the area of penetrable pack which surrounds the impenetrable central area.[13]

It may be affirmed that no other area of pack ice upon the surface of our globe, save that of the nearly circumscribed Arctic Sea, can for impenetrability be compared with that of the central and western Weddell Sea.

Weddell named the sea of his alleged voyage, "The Sea of George the Fourth, Navigable." The British Admiralty soon afterward changed this to "Weddell Sea" to honor its captain in the Royal Navy, to which name should at least have been added *unnavigable*. An appropriate name would be "Icy Sea," since both for size and unnavigability it is without a parallel save only for the largely enclosed Arctic Ocean.

University of Michigan,
January, 1939.

A Criticism and a Rejoinder

Editor's Note.—Pertinent matter, supplementary to the foregoing paper, has been brought out by Dr. Arthur Hinks, in seven points, to which Professor Hobbs has made specific rejoinder, at the editor's request. The criticisms are levelled chiefly against the abstract of a paper by Professor Hobbs, "James Weddell Revealed as a Fake Explorer of the Antarctic," a presentation related to the present article but distinct from it; and partly against "The Discoveries of Antarctica within the American Sector," referred to in footnote 1 above. Dr. Hinks has not seen the article here published, which was already in proof when the editor received his criticisms of the abstract.

Dr. Hinks's seven points are quoted in italics; Professor Hobbs's rejoinders are printed in roman type.

1. Weddell's cruise southwards was not made between the 40th and 50th meridians. He went southwards round about the 30th, and west of the 40th only as he was getting out of the Weddell Sea on his return. He did not cross the 50th until on his way home from South Georgia via the Falkland Islands.

Dr. Hinks here calls attention to an error of mine in reading the three for a five from the map (30th for 50th) when writing. The error occurs on page 44 of the monograph, "The Discoveries of Antarctica within the American Sector," and this was copied into the abstract. The matter is not very

[13] I am indebted to Consul Bjarne Aagaard for this valuable information.

important, since Weddell's map is correctly reproduced in Plate XVIII of the monograph; the basic issue is covered below under point 2.

2. His farthest south, 74° 15′, is not six degrees farther south than anyone has ever gone on such a course before or since. Filchner in 1912 went to about 77° 55′ and Shackleton in 1915 to about 76° 15′ in much the same longitudes as Weddell. They were both afterwards beset in the pack, whereas Weddell had an exceptionally open season and got away clear.

The longitudes of Filchner's and Shackleton's cruises were not "much the same" as Weddell's (see map, Fig. 1, above). Filchner on his southward cruise was considerably to the eastward of both Weddell's tracks as shown on his map, yet Filchner was beset in the pack for much of the way on the southern cruise (above, pp. 162–164) and was beset all the way back in a besetment which extended over ten months. Shackleton's southward track was an average of ten degrees of longitude farther east than Weddell, where he had the advantage of nearness to the land; yet he was surrounded by pack nearly all the way. On his return cruise he was as far to the west of Weddell's westernmost track as he had been to the east of Weddell's easternmost on the southward cruise. His ship was however beset, crushed and sunk, and the crew was released only after months of drifting on the pack (see Fig. 1, and pp. 164–165).

3. Weddell's Chart of South Shetland facing page 132 of his book "A Voyage towards the South Pole" delineates as surveyed the Southern coasts of the group [South Shetland Islands], but leaves several of the Northern unshown, because unapproachable. Hobbs treats the single track of the Jane *and* Beaufoy *in January 1822 as if it were Weddell's only visit to the group, whereas he had spent two whole seasons there.*

Hinks is here in error. I treated Weddell's track of 1821 as well as 1822 (see Plate XVI of monograph), and his other tracks were not within the area of the map. It is indeed curious that Weddell, if he had actually surveyed all the southern shores of the islands, should on his larger-scale chart have indicated incompletely the northern shores of three of the eleven main islands, for he has indicated details of the reefs which were less than two miles distant from these shores. This is remarkable since the northern coast is the only one which he skirted at all, and this at a great distance. His main chart, on the other hand, does have the northern coasts represented.

About the tracks of his ships the legend to his chart is most definite. It is, "Chart of the Tracks of the Vessels *Jane* and *Beaufoy* on Their Southern Voyages of Investigation in 1820, 1821, 1822, 1823 and 1824 by J. Weddell R.N." In order to explain the absence of any tracks near the shores of the South Shetland Islands, an eminent British reviewer of the monograph has offered the ingenious hypothesis (*Nature*, issue of April 29, 1939), that

Weddell surveyed the shores from boats. Such boat journeys, if made, would clearly have ranked among the most remarkable in all history, and they would have merited at least a casual mention in Weddell's report.

4. His map is not copied from Powell's map of 1822. The outlines are strikingly different. At least three copies of Powell are in the Hydrographic Office, and one in private hands. Only Hobbs, more than a century later, alleges it was "suppressed."

Most geographers who will compare the map of Weddell (Plates XVII and XVIII of my monograph) with the Palmer-Powell map which is reproduced on Plate XVI, will be inclined to believe that Weddell has sketchily copied from the Palmer-Powell map; and the lists of features printed on pages 40–42 of my monograph are convincing. Yet Weddell does not even mention either Palmer or Powell, though the Palmer-Powell map was published by the Admiralty in 1824 and at least one copy has been at the Hydrographic Office. Dr. Hinks states that there are three copies there, and one also in private hands, presumably in England. I anticipate that still others will yet come to light.

5. Trinity Land of Bransfield's map[14] *and of Weddell's, is not imaginary. It is the land discovered by Bransfield in January 1820 and seen by Palmer on 18 November 1820. Weddell showed it conventionally as not visited by him, but inserted from reliable reports.*

If "Trinity Land" had indeed been discovered by Bransfield in January of 1820, it is strange that it had not been reported in the narrative of his cruise as published by Surgeon Young, or indeed by anyone for more than two years, only to appear upon a map published by Weddell in 1825, when it is said to have been "laid down from the information of respectable commanders of ships," though without mentioning any discoverer in particular.

6. Weddell called the sea "navigable" because he found it so. Filchner and Shackleton went much further south than Weddell, and so it is not "now recognized as wholly unnavigable," nor "perpetually covered with pack ice."

Here the question is raised whether the Weddell Sea is navigable. To navigate over the sea, according to the dictionaries, is to steer, direct or control the course of a ship, and further as used by Weddell, a sailing ship. This does not mean utilizing leads of the pack to go other than where one would, or ramming to break the ice wherever possible, or to being set back or drifted to right or left of the course. This however was the experience of both Filchner and Shackleton within more favorable parts of the sea. The Weddell Sea is by all regarded as unnavigable, and powerful whaling vessels with every incentive to follow the whales through open pack, have not penetrated the portion of the sea where Weddell's alleged cruise was made.

[14] [Discussed in Hobbs's monograph; not mentioned in the *Annals* abstract.—Ed.]

Explorers also with the most alluring of unknown areas beyond this sea have not penetrated it. Peary alone made the plan to advance through the pack with use of the powerful ice-breaking ship *Roosevelt*, but was obliged to abandon the project for lack of funds.

Professor Griffith Taylor in his discussion of the paper when it was read at Cambridge stated that his own experience in the Ross Sea, where pack ice gives trouble to navigators and where in some seasons the pack is more easily navigated than in others, had led him to think that the Weddell Sea might in some seasons be navigable. I asked in rejoinder if he knew of anyone who had failed to navigate the Ross Sea who had attempted it, or of anyone other than Weddell who had claimed to have navigated the Weddell Sea within the portion of Weddell's alleged cruise. His reply was "No."

7. The life of James Weddell in the Dictionary of National Biography, from which Hobbs quotes elsewhere,[15] *says that his Commander on the Avon brig in 1812, afterwards Admiral of the Fleet Sir George Sartorius, wrote of Weddell in 1839 "one of the most efficient and trustworthy officers I have met with in the course of my professional life." Yet knowing this, Hobbs a hundred years later has the effrontery to say that his narrative is fiction, and to call him a Fake Explorer, on grounds which are easily shown, as above, to be entirely false.*

This omission is perhaps sufficiently explained by the fact that my summary of about 250 words was made from more than a page of rather fine print of the Dictionary.

[15] The Discoveries of Antarctica within the American Sector, p. 39.